

UL 514A

ISBN 0-7629-121-7

Metallic Outlet Boxes

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety for Metallic Outlet Boxes, UL 514A

Ninth Edition, Dated December 27, 1996

Revisions: This Standard contains revisions through and including November 30, 2001.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding reference.

Future Effective Dates	References
December 20, 2001	14.1.9, 14.1.10, 14.1.11, 18.1, 26.2.1, 26.2.2, 26.2.3, Table 26.1, 26.3.2A, 26.3.3, 33.16, 33.16A, 33.16B, 33.26
June 20, 2003	32A.1.2, 32A.2.1, 32A.2.2, 32A.2.3, 32A.2.4, 33.25

The revisions dated November 30, 2001 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

UL's Standards for Safety are copyrighted by UL. Neither a printed copy of a Standard, nor the distribution diskette for a Standard-on-Diskette and the file for the Standard on the distribution diskette should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

UL will attempt to answer support requests concerning electronic versions of its Standards. However, this support service is offered on a reasonable efforts basis only, and UL may not be able to resolve every support request. UL supports the electronic versions of its Standards only if they are used under the conditions and operating systems for which it is intended. UL's support policies may change from time-to-time without notification.

UL reserves the right to change the format, presentation, file types and formats, delivery methods and formats, and the like of both its printed and electronic Standards without prior notice.

Purchasers of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgement (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

If a single-user version electronic Standard was purchased, one copy of this Standard may be stored on the hard disk of a single personal computer, or on a single LAN file-server or the permanent storage device of a multiple-user computer in such a manner that this Standard may only be accessed by one user at a time and for which there is no possibility of multiple concurrent access.

If a multiple-user version electronic Standard was purchased, one copy of the Standard may be stored on a single LAN file-server, or on the permanent storage device of a multiple-user computer, or on an Intranet server. The number of concurrent users shall not exceed the number of users authorized.

Electronic Standards are intended for on-line use, such as for viewing the requirements of a Standard, conducting a word search, and the like. Only one copy of the Standard may be printed from each single-user version of an electronic Standard. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of an electronic Standard. Because of differences in the computer/software/printer setup used by UL and those of electronic Standards purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

Copyright © 2001 Underwriters Laboratories Inc.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1	November 30, 2001
2-2B	June 4, 2001
3	December 20, 1999
4	November 30, 2001
5-6A	June 4, 2001
6B	December 20, 1999
7	July 23, 1998
8	December 27, 1996
9-10	December 20, 1999
11-12	December 27, 1996
13-17	June 4, 2001
18	November 30, 2001
19-22B	June 4, 2001
23	December 20, 1999
24-26B	June 4, 2001
27	November 30, 2001
28-29	December 27, 1996
30	July 23, 1998
31	June 4, 2001
32	November 30, 2001
33-36B	June 4, 2001
37	December 20, 1999
38	June 4, 2001
38A	November 30, 2001
38B-46B	June 4, 2001
47-49	December 20, 1999
50-52	June 4, 2001
SA1-SA2	December 20, 1999
SA3-SA4	December 27, 1996
SR1-SR2	June 4, 2001

No Text on This Page

DECEMBER 27, 1996
(Title Page Reprinted: November 30, 2001)

1

UL 514A

Standard for Metallic Outlet Boxes

The first through sixth editions were numbered UL 514.

First Edition – August, 1928
Second Edition – November, 1941
Third Edition – March, 1951
Fourth Edition – August, 1969
Fifth Edition – May, 1974
Sixth Edition – May, 1979
Seventh Edition – December, 1983
Eighth Edition – December, 1991

Ninth Edition

December 27, 1996

The most recent designation of ANSI/UL 514A as an American National Standard (ANSI) occurred on October 2, 2001.

This ANSI/UL Standard for Safety, which consists of the Ninth Edition including revisions through November 30, 2001, is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to the UL Northbrook Standards Department, 333 Pfingsten Road, Northbrook, IL 60062.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

The Department of Defense (DoD) has adopted UL 514A on May 23, 1990. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

ISBN 0-7629-0121-7

COPYRIGHT © 1974, 2001 UNDERWRITERS LABORATORIES INC.

No Text on This Page

CONTENTS

FOREWORD	4
-----------------------	---

INTRODUCTION

1 Scope	5
2 General	5
2.1 Terminology	5
2.2 Undated references	6
2.3 Units of measurement	6
3 Glossary	6

CONSTRUCTION

4 General	6A
5 Materials	6A
6 Thickness	7
7 Protection Against Corrosion	8
8 Assembly	9
9 Dimensions	10
9.1 Boxes	10
9.2 Conduit bodies	10
10 Holes	12
11 Knockouts	15
12 Closures	15
13 Connections for Wiring Systems	16
13.1 Boxes	16
13.2 Covers	21
14 Supports	21
14.1 Boxes	21
14.2 Conduit bodies	23
15 Studs	23
16 Grounding	23
17 Wet and Damp Locations Use	24
18 Ceiling-Suspended Fan Support	25
19 Partitions	26

PERFORMANCE

20 General	26A
21 Metallic-Coating-Thickness Test	26A
22 Tests on Alternate Corrosion Protection Systems	27
22.1 General	27
22.2 Air oven conditioning exposure	28
22.3 Resistance to ultraviolet light and water	28
22.4 Resistance to salt spray (fog)	29
22.5 Resistance to moist carbon dioxide-sulfur dioxide-air	29
23 Volume Verification Test	29
24 Test on Knockouts	30
24.1 All knockouts	30
24.2 Concentric and eccentric knockouts	30

25 Tests on Closures	32
26 Tests on Supports	32
26.1 General	32
26.2 Fixture support	33
26.3 Ceiling-suspended fan support	34
26.4 Boxes intended to be installed in a finished structure	36
26.4A Boxes for support of products up to 50 pounds (22.7 kg)	36A
26.5 Polymeric supporting means	36A
26.6 Support for Floor Boxes	37
27 Tests on Studs	37
28 Test on Mounting Plates	38
29 Wet and Damp Locations Test	38A
29.1 General	38A
29.2 Resistance to moisture	38A
29.3 Water-spray apparatus	41
29.4 Resistance to ultraviolet light and water	43
29.5 Sealing compound	43
29.6 Gaskets	44
30 Concrete-Tightness Test	44
31 Scrub-Water-Tightness Test	46
32 Resistance Test	46
32A Tests on Floor Boxes	46
32A.1 General	46
32A.2 Scrub-water exclusion test	46
32A.3 Floor box and cover loading test	46A
32A.4 Resistance test	47

MARKING

33 General	48
34 Instructions	51

SUPPLEMENT SA - METALLIC OUTLET BOXES FOR MARINE USE

GENERAL

SA1 Scope	SA1
SA2 Glossary	SA1

CONSTRUCTION

SA3 General	SA1
SA4 Mounting	SA1
SA5 Supply Connections	SA1

PERFORMANCE

SA6 Watertightness TestSA2
SA7 Drip-proof TestSA2
SA8 Air-Oven Conditioning Test- GasketsSA2
SA9 Salt Spray TestSA2

MARKING

SA10 GeneralSA3

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover metallic outlet boxes, flush-device boxes, floor boxes, concrete boxes, extension rings, covers, flush-device cover plates, conduit bodies, bar hangers, and bar-hanger assemblies to be employed in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements do not cover outlet boxes or covers for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

1.3 These requirements do not cover junction boxes for use with underwater lighting fixtures for swimming pools.

1.4 These requirements do not cover cabinets and cutout boxes, boxes and covers intended for use with raceway systems for surface wiring other than rigid or flexible conduit or electrical metallic tubing, nor boxes with a volume of more than 100 cubic inches (1639 cm³), except multiple-gang, flush-device boxes, and conduit bodies usually for the larger trade sizes of conduit.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.5 revised June 4, 2001

2 General

2.1 Terminology

2.1.1 In the following text, a requirement that applies only to one or more types of box is so identified by a specific reference in that requirement to the type or types of boxes involved. Absence of such reference indicates that the requirement applies to all types of boxes unless the context indicates otherwise.

2.2 Undated references

2.2.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

2.3 Units of measurement

2.3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.3.1 revised June 4, 2001

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 CLAMP – Part of a box intended to secure raceway, tubing, or cable to the box.

3.3 CONCRETE BOX – A box intended for support in concrete. It may be constructed to permit end-to-end extension and the application of covers on two sides. It is not intended for installation in a floor.

3.4 CONDUIT BODY – A separate part of a raceway system intended to provide access to the interior of the system through one or more removable covers at a junction of two or more sections or at a terminal point. Boxes, such as FS, FD, and larger boxes, and fittings, such as capped elbows and service entrance elbows, are not considered to be conduit bodies.

3.5 EXTENSION RING – A ring, that need not be round, intended to extend the sides of an outlet box or flush-device box to increase the box depth.

3.6 FLOOR BOX – A box provided with means for flush mounting in a floor. It is sealed to exclude scrub water at the floor level.

3.7 FLUSH-DEVICE BOX – A box provided with ears or flanges with tapped holes spaced to accept the mounting yoke of a wiring device or devices. The box is provided with a mounting means, that may be the raceway system on cast boxes with threaded hubs or the equivalent, and it may or may not include clamps for connection of cable, tubing or conduit.

3.8 FLUSH-DEVICE COVER PLATE – A cover that is usually but not necessarily decorative. It does not support a wiring device, but is intended to close a flush-device box and cover the edges of the wall opening in which the box is located.

3.9 OUTLET BOX – A metal box used on a wiring system, usually at an outlet. It is provided with means for connection to a wiring system and intended primarily to enclose splices and wiring devices or to support a fixture or other equipment intended for similar installation. The box may or may not be provided with studs or a bar hanger or with clamps for securing cable, tubing, or conduit.

3.10 OUTLET BOX COVER – A cover intended to provide enclosure for the face of a box. The cover may or may not support, or be provided with means for support of, a wiring device, pendant cord, or the like.

3.11 PARTITION – A barrier used to separate sections of a box.

3.12 RAISED-FLOOR BOX – A floor box intended for use in raised floors, such as in electronic computer/data processing equipment rooms.

Added 3.12 effective December 20, 2001

CONSTRUCTION

4 General

4.1 The construction of a box and a box cover shall have the strength and rigidity necessary to resist the rough handling that can be encountered during shipment, installation, and use.

5 Materials

5.1 A box, a box cover, and a flush-device cover plate shall be made of metal. See 5.2.

5.2 A zinc cover or a zinc cast outlet box shall comply with the applicable requirements in this standard, and additional examination and test, as needed, to determine that the box or cover is acceptable for the application.

No Text on This Page

5.3 A gasket that is depended upon to exclude water or moisture shall be made of:

- a) Material that has been investigated for use as gasket material,
- b) Rubber that complies with the requirements in 29.6.1 and 29.6.2, or
- c) Expanded (foam) closed-cell rubber that complies with the requirements in 29.6.3 and 29.6.4.

5.4 A partition shall comply with the requirements in Partitions, Section 19.

Effective date for 5.4 changed from February 2, 1998 to December 15, 1998

6 Thickness

6.1 The thickness of a box and an outlet box cover made of sheet metal other than sheet aluminum shall not be less than 0.0625 inch (1.59 mm).

Exception No. 1: The minimum thickness at or within 1/4 inch (6.4 mm) of any right-angle bend in a drawn sheet-steel box may be 0.041 inch (1.04 mm).

Exception No. 2: The average thickness of the sides and ends of a drawn box may be 0.058 inch (1.47 mm) based on three measurements made on the side and end of the box but not less than 3/8 inch (9.5 mm) from a right-angle bend. The three measurements are to be made in a line perpendicular to the front of the box at a point 1/4 inch from the front, at a point 1/4 inch from the right-angle bend at the back, and at a point equidistant between the two.

Exception No. 3: A laminated sheet-steel cover may be constructed of steel having a thickness less than that required if the total thickness of the assembled cover is not less than 0.0625 inch.

6.2 An outlet box and an outlet box cover made of sheet aluminum alloy shall not be less than 0.091 inch (2.31 mm) thick, except that a sharply bent section having a radius of curvature not more than 1/4 inch (6.4 mm) may be less than 0.091 inch but not less than 0.087 inch (2.21 mm) thick. The aluminum alloy shall have a tensile strength not less than 17,000 psi (117 MPa).

Exception: An outlet box and box cover made of sheet aluminum having a tensile strength not less than 34,000 psi (234 MPa) may be not less than 0.067 inch (1.70 mm) thick if it has acceptable properties as determined by investigation. The investigation is to take into consideration:

- a) *Resistance to impact;*
- b) *Resistance to crushing;*
- c) *Strength of threaded openings;*
- d) *Ease of knockout removal;*
- e) *Mechanical strength; and*
- f) *Resistance to arcing.*

6.3 The thickness of a cast-metal box and an outlet box cover shall not be less than 1/8 inch (3.2 mm).

Exception No. 1: The wall of a malleable-iron box and a die-cast or permanent-mold-cast aluminum, brass, or bronze box may be not less than 3/32 inch (2.4 mm) thick.

Exception No. 2: A wall thickness of not less than 3/32 inch is acceptable for clearance of a cover screw in the area directly beneath the cover mounting lug if that area is not larger than 0.050 square inch (32.26 mm²) and has no straight-line dimension more than 1/2 inch (12.7 mm).

Exception No. 3: The thickness of a cast metal cover of other than malleable iron, die-cast or permanent-mold-cast aluminum, brass, or bronze may be less than required but not less than 3/32 inch, if the cover is lined with firmly attached insulating material not less than 1/32 inch (10.8 mm) thick.

6.4 A flush-device cover plate shall be:

- a) Steel not less than 0.030 inch (0.76 mm) thick; or
- b) Copper alloy, aluminum, or die-cast-zinc not less than 0.040 inch (1.02 mm) thick; or
- c) Other acceptable material.

7 Protection Against Corrosion

7.1 All surfaces of:

- a) A ferrous metal box and all attached ferrous metal parts of a box, including screws;
- b) A ferrous metal box cover; and
- c) A ferrous metal flush – device cover plate,

shall be protected against corrosion. A zinc or cadmium coating on an interior surface shall not have an average thickness less than 0.00015 inch (0.0038 mm) nor a minimum thickness less than 0.0001 inch (0.0025 mm). A zinc or cadmium coating on an exterior surface shall not have an average thickness less than 0.0005 inch (0.013 mm) nor a minimum thickness less than 0.0004 inch (0.0102 mm).

Exception No. 1: Stainless steel need not be so protected.

Exception No. 2: Cut edges, and punched holes in a surface formed from galvanized stock, the area under the heads of screws securing the sides of a gangable switch box, and the threaded surfaces of tapped holes in a box need not be so protected.

Exception No. 3: Spot or projection welds need not be so protected but shall have a protective coating as determined by visual inspection.

Exception No. 4: The thickness on screws and on interior surfaces not able to be contacted by a 3/4 inch (19.1 mm) diameter ball is not specified but the presence of a coating is to be determined by visual inspection.

Exception No. 5: The surfaces of a cast – iron or a malleable – iron box and cover shall be protected against corrosion by zinc, cadmium or organic coating. The thickness of this protective coating is not specified but the presence of a protective coating is to be determined by visual inspection.

Exception No. 6: Surfaces that have a corrosion protection system in accordance with Tests on Alternate Corrosion Protection Systems, Section 22, need not be so protected.

7.2 With respect to the requirements of 7.1, the average thickness is to be determined by averaging of a minimum of three readings, on three different surfaces, if possible. If the readings are taken on the same surface, then the locations at which these readings are taken are to be equally spaced along that surface.

7.3 Unless it is obvious that one surface of a box cover or the like is intended for use only on the side toward the interior of the box, both surfaces shall be provided with corrosion protection as required for exterior surfaces.

7.4 The outside of an aluminum outlet box, such as a floor box, that is intended for use in concrete or cinder fill shall be coated with asphalt – base paint, two coats of baked enamel, or the equivalent.

7.5 The area beneath adjustable or removable parts, such as beneath mounting ears and clamps, shall be plated in accordance with 7.1.

7.6 A spring used to close a cover over a wiring device shall be of a material that is inherently resistant to corrosion.

8 Assembly

8.1 An assembly screw employed in a box shall not have fewer than the number of threads per inch in accordance with the Standard for Unified inch Screw Threads (UN and UNR Thread Form, NA), ANSI/ASME B1.1-1989, for the diameter of the screw.

8.2 A sheet metal screw is not acceptable for assembly of a box.

8.3 An outlet box intended to support a fixture, but not intended to support a ceiling-suspended fan, may or may not be provided with two or more steel No. 8-32 cover retaining screws, and shall employ threaded cover retaining screw holes for No. 8-32 screws.

8.4 An outlet box intended to support a fixture, and also intended to support a ceiling-suspended fan, shall comply with Ceiling-Suspended Fan Support, Section 18.

8.5 A box intended for use with a partition shall have provision for proper placement of the partition during and after installation.

Effective date for 8.5 changed from February 2, 1998 to December 15, 1998

8.6 An outlet box cover constructed to support a duplex flush receptacle shall be provided with more than one securement point for the receptacle.

Added 8.6 effective December 20, 2001

9 Dimensions

9.1 Boxes

9.1.1 A flush-device box shall have a minimum internal width not less than 1-3/4 inches (44.5 mm).

Exception: The minimum width may be not less than 1 inch (25.4 mm) for a box intended to accommodate a narrow wiring device.

9.1.2 The volume of a flush-device box provided with internal clamps for nonmetallic sheathed cable shall not be less than 10 cubic inches (163.9 cm³).

9.1.3 The volume of a side pocket provided to increase the volume of an outlet box or a flush-device box shall be calculated using a depth of pocket not more than the smallest dimension of the opening into that side pocket.

9.1.4 The volume of any box, raised cover, or extension ring that significantly increases the volume of a box assembly shall be verified as described in Volume Verification Test, Section 23, or by any equivalent means. See 33.11, 33.12, and Table 33.1 for marking requirements.

9.1.5 A box provided with a partition shall have the volume of each partitioned section verified as described in Volume Verification Test, Section 23, or by any equivalent means. See 33.11 for marking requirements.

9.2 Conduit bodies

9.2.1 A conduit body shall have a cross-sectional area not less than that specified in Table 9.1, based on the largest size raceway that may be connected to it.

Table 9.1
Cross-sectional area of conduit bodies

Trade size of raceway, inches	Cross section,		Trade size of raceway, inches	Cross Section,	
	square inches	(cm ²)		square inches	(cm ²)
3/4	1.067	(6.88)	3	14.785	(95.39)
1	1.729	(11.15)	3-1/2	19.774	(127.57)
1-1/4	2.991	(19.30)	4	25.461	(164.26)
1-1/2	4.072	(26.27)	4-1/2	31.894	(205.77)
2	6.711	(43.30)	5	40.012	(258.14)
2-1/2	9.576	(61.78)	6	57.781	(372.78)

9.2.2 A conduit body having provision for the connection of conduit or tubing larger than the 1/2-inch-trade size shall comply with the requirements in 9.2.3 and 9.2.4.

Exception: A conduit body marked for use only with No. 6 AWG (13.3 mm²) or smaller conductors need not comply.

9.2.3 A conduit body that does not change the direction of wiring passing through it shall have a length not less than eight times the trade diameter of the largest tubing or conduit that may be connected to it. The length is to be measured inside the conduit body from the end stop of the conduit hub away from the center of the center of the box to a like point on the conduit hub on the opposite wall, or for a conduit body having a single raceway entry, to the opposite wall.

Exception: A shorter conduit body may be investigated for installation of a combination of conductors less than the maximum fill permitted in accordance with the National Electrical Code, ANSI/NFPA 70-1990. See 33.13.

9.2.4 A conduit body intended to permit a change in the direction of the axis of a tubing or conduit system shall have a distance inside the body between each tubing or conduit entry and the entry hub on the opposite wall of the body to enclose a common conductor not less than that specified in (a), or between each tubing or conduit entry and the opposite wall not less than the sum of (a) and (b):

- a) Six times the trade diameter of the largest tubing or conduit for which the body is intended.
- b) The sum of the diameters of all other tubing or conduit entries in the same wall of the body.

Exception No. 1: A conduit body having smaller dimensions may be investigated for installation of a combination of conductors, including No. 4 AWG (21.2 mm²) or larger, that is less than the maximum fill permitted in accordance with the National Electrical Code, ANSI/NFPA 70-1990. See 33.13.

Exception No. 2: A conduit body having a raceway entry in the wall opposite the removable cover may have a distance from the cover to the opposite wall not less than that specified in Table 9.2.

Table 9.2
Space inside a conduit body

Maximum size of wire,		Minimum distance to cover,	
AWG or MCM	(mm ²)	inches	(mm)
14 – 10	(2.1 – 5.3)	Not Specified	
8 – 6	(8.4 – 13.3)	1-1/2	(38.1)
4 – 3	(21.2 – 26.7)	2	(50.8)
2	(33.6)	2-1/2	(63.5)
1	(42.4)	3	(76.2)
0, 2/0	(53.5, 67.4)	3-1/2	(88.9)
3/0, 4/0	(85.0, 107.2)	4	(102)
250	(127)	4-1/2	(114)
300 – 350	(152 – 177)	5	(127)
400 – 500	(203 – 253)	6	(152)
600 – 700	(304 – 355)	8	(203)
750 – 900	(380 – 456)	8	(203)
1000 – 1250	(507 – 633)	10	(254)
1500 – 2000	(760 – 1013)	12	(305)

9.2.5 With reference to 9.2.4, the distance is to be measured from points located at each of the raceway entries where the axis of the raceway passes through the plane of the end stop of the conduit hub to the inside surface of the cover.

10 Holes

10.1 An opening hole in a box, such as a mounting-screw hole, shall have no dimension larger than 17/64 inch (6.7 mm).

Exception: A slot with one dimension not larger than 5/8 inch (15.9 mm) and the other dimension not larger than 1/8 inch (3.2 mm) is acceptable in a box that is intended for use within a complete metal enclosure only.

10.2 The area of a prying-out hole or slot shall not be more than 0.040 square inch (25.81 mm²).

10.3 A prying-out hole or slot shall not be in a knockout of the 1/2-inch or larger trade size.

10.4 The total area of all open holes in any one side or end of a box shall not be more than 0.200 square inches (129.03 mm²). The total area of all open holes in the entire box and in the bottom of the box shall not be more than that specified in Table 10.1. See 10.5.

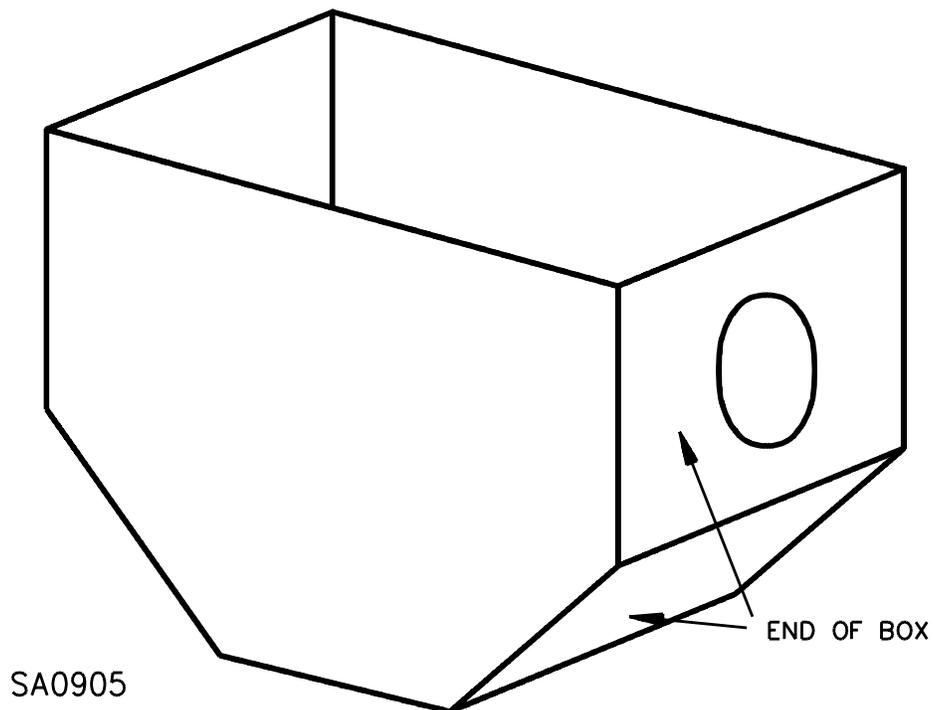
10.4 effective February 2, 1998

Table 10.1
Area of openings

Type of box	Maximum area of all openings,		Maximum area of openings in the bottom,	
	square inches	(mm ²)	square inches	(mm ²)
Single unit, or 2- to 4-gang multiple unit	0.452	(291.61)	0.332	(214.19)
5- to 7-gang multiple unit	0.784	(505.81)	0.664	(428.39)
8-gang or larger multiple unit	1.116	(720.00)	0.996	(642.58)

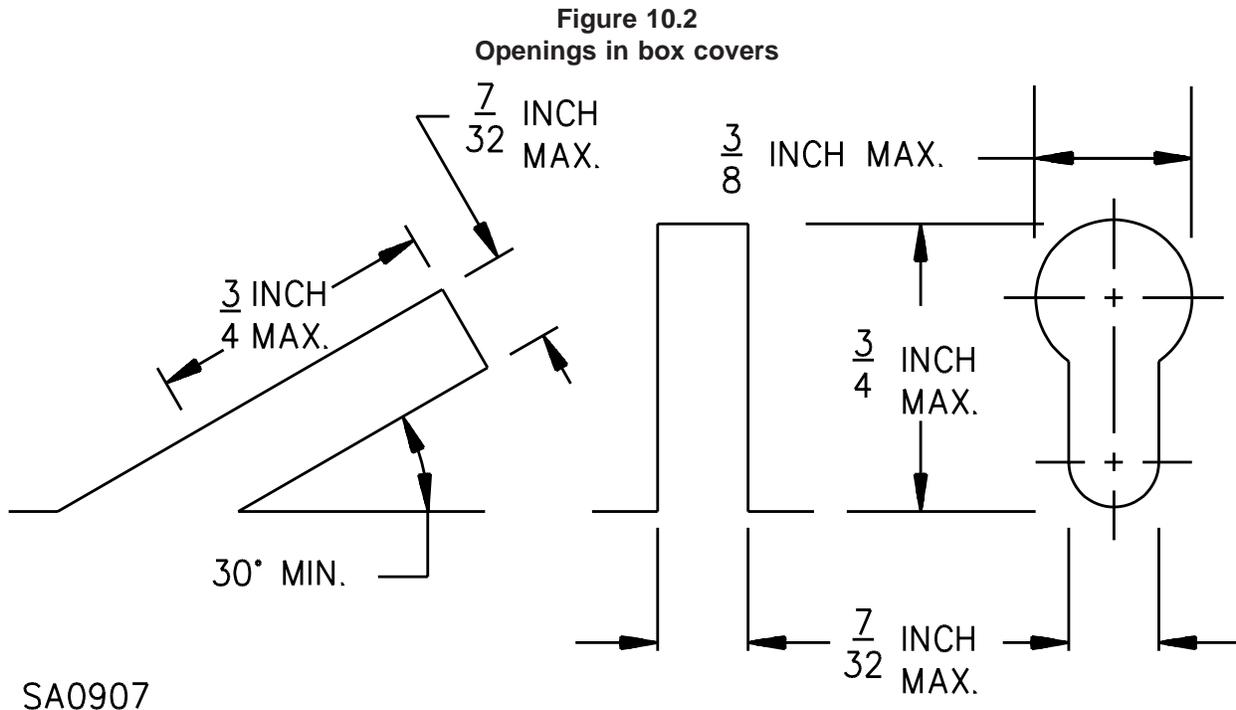
10.5 With reference to the requirement in 10.4, the area of a prying-out hole or slot in an area of the box where a clamp is provided is to be disregarded, except that, if the prying-out hole or slot extends outside the area of the knockout, one-half the area of the slot or hole is to be used in computing the total area of the openings. The area of a prying-out slot or hole in an area of the box where a clamp is not provided is to be included, without reduction, in computing the total area of openings. Openings adjacent to an integral ear for the purpose of die clearance only may be disregarded in computing the area of the unused openings. The area of one tapped hole intended for use with a No. 10-32 grounding screw is to be disregarded. In computing the area of openings, an oblique side of a box is considered to be a part of the end of the box as illustrated in Figure 10.1.

Figure 10.1
End of box



10.6 A box cover shall have no open holes except those for mounting to a box as described in 10.7 and 10.8, and those mentioned in 10.9 and 10.10. See 13.2.1 and 13.2.2.

10.7 Except in a cover for a multiple-gang flush-device box, not more than four openings shall be provided for mounting a cover to a box. Each opening shall be a round hole, a single (not forked) slot, or a keyhole slot. A round hole for mounting shall not be larger than $7/32$ inch (5.6 mm) in diameter. A slot shall have dimensions not larger than those specified in Figure 10.2.



10.8 A cover for a multiple-gang flush-device box shall not have more than two mounting holes for each gang involved.

10.9 A cover that has mounting slots, keyhole slots, or both, but no mounting holes may have a single hole not more than 0.200 inch (5.08 mm) in diameter located not more than 1/4 inch (6.4 mm) from the outer edge of the cover, except that a raised cover may have that hole located not more than 1/2 inch (12.7 mm) from the outer edge of the cover.

10.10 A hole may be provided that will be closed in the field by a wiring device, such as a switch, receptacle, or lampholder, or by a flush-device cover plate.

10.11 There shall be no holes in a conduit body.

Exception No. 1: A conduit body may have holes for the connection of conduit or electrical metallic tubing.

Exception No. 2: A conduit body may have screw holes for mounting the cover.

11 Knockouts

11.1 A knockout shall completely cover the opening in which it is located, and the clearance between the knockout and the opening shall not be more than 0.010 inch (0.25 mm).

12 Closures

12.1 Unless threaded or provided with a threadless connector, an opening in an outlet box intended for the entrance of a wiring system shall be effectively closed.

12.2 Other than as noted in 12.3, a sheet-metal plug or plate employed to close an unused opening in a metal box shall not be less than 0.054 inch (1.38 mm) thick if of steel, and not less than 0.081 inch (2.06 mm) thick if of aluminum.

12.3 A sheet-steel plug or plate not less than 0.010 inch (0.25 mm) thick and constructed so that it can not be removed by a force of 20 pounds (89 N) applied in any direction most likely to remove it is acceptable for closing an unused opening that is:

- a) In a floor box that is:
 - 1) Intended for installation only in concrete; and
 - 2) Marked or shipped in a carton marked as required by 33.10.
- b) Threaded; and
- c) Not larger than 1-1/2-inch trade size.

12.3 revised December 20, 1999

12.4 If a plug or plate as mentioned in 12.2 is laminated, the total thickness shall not be less than 0.054 inch (1.38 mm). The construction of a plug or plate employing a securing screw shall be such that the enclosure will be effective even though the screw becomes slightly loosened.

12.5 A cast-metal plug for closing an opening in an outlet box shall not be thinner than 1/16 inch (1.6 mm) if of die-cast zinc, die-cast aluminum, or malleable iron, and shall not be thinner than 1/8 inch (3.2 mm) if of sand-cast aluminum or cast iron. A die-cast zinc plug shall not be larger than the 1-inch trade size.

12.6 A phenolic plug employed to close an unused opening in a box shall not be less than 0.100 inch (2.54 mm) thick.

12.7 An iron or steel plug or plate employed to close an unused opening in an outlet box shall be protected against corrosion in accordance with the requirements in Protection Against Corrosion, Section 7 and Metallic-Coating-Thickness Test, Section 21.

13 Connections for Wiring Systems

13.1 Boxes

13.1.1 General

13.1.1.1 Other than as noted in 13.1.1.2, a box shall be provided with means for connection to a wiring system.

13.1.1.2 A hole for the connection of conduit may be drilled and tapped in the field. A flat area as specified in 13.1.1.9 shall be provided for this purpose, and the thickness of the box wall where the drilling is to be done shall not be less than 17/64 inch (6.7 mm).

13.1.1.3 If threads for the connection of conduit are tapped all the way through a hole in a box wall, or if an equivalent construction is employed, there shall not be less than 3-1/2 nor more than five threads in the metal and the construction shall be such that a conduit bushing can be attached as intended.

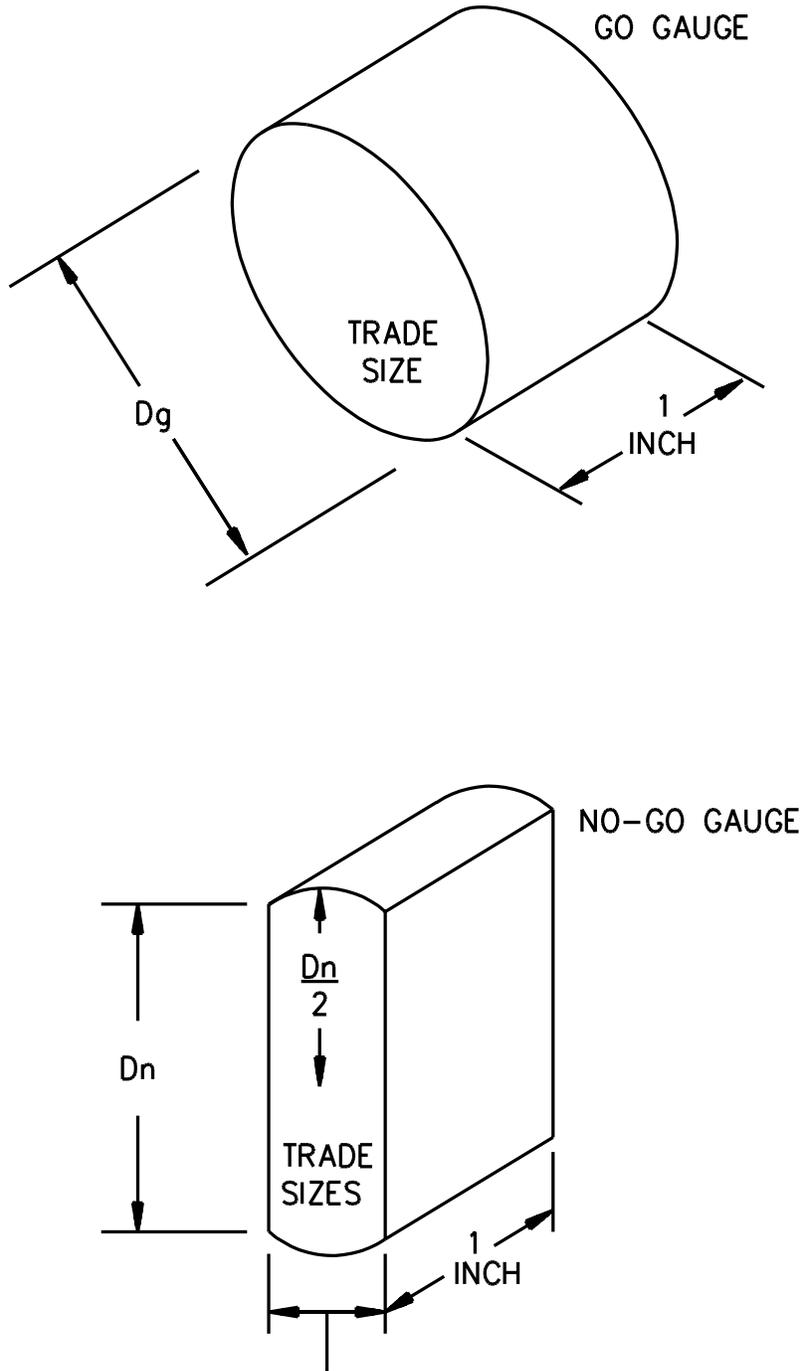
13.1.1.4 If threads for the connection of conduit are not tapped all the way through a hole in a box wall, conduit hub, or the like, there shall not be less than five full threads in the metal and there shall be a smooth, rounded inlet hole for the conductors that shall afford protection to the conductors equivalent to that provided by a standard conduit bushing. The throat diameter of an inlet hole shall be within the limits specified in Table 13.1 and compliance shall be determined by applying the limit gauges, illustrated in Figure 13.1, having the dimensions specified in Table 13.2.

13.1.1.5 Clamps or fasteners shall be supplied as a part of any metal box provided with a knockout of a trade size smaller than 1/2 inch. If the clamps or fasteners are movable, they need not be supplied for each such knockout in the box.

Table 13.1
Throat diameter of inlet hole

Trade size of conduit, inches	Throat diameter of hole – inches (mm)			
	Minimum		Maximum	
3/8	0.444	(11.28)	0.493	(12.52)
1/2	0.560	(14.22)	0.622	(15.80)
3/4	0.742	(18.85)	0.824	(20.93)
1	0.944	(23.98)	1.049	(26.64)
1-1/4	1.242	(31.55)	1.380	(35.05)
1-1/2	1.449	(36.80)	1.610	(40.89)
2	1.860	(47.24)	2.067	(52.50)
2-1/2	2.222	(56.44)	2.469	(62.71)
3	2.761	(70.13)	3.068	(77.92)
3-1/2	3.193	(81.10)	3.548	(90.12)
4	3.623	(92.02)	4.026	(102.26)
4-1/2	4.055	(103.00)	4.506	(114.45)
5	4.542	(115.37)	5.047	(128.19)
6	5.458	(138.63)	6.065	(154.05)

Figure 13.1
Limit gauges for throats of bushings



$\frac{1}{4}$ INCH FOR THE $\frac{1}{2}$ - 2 INCH TRADE SIZES

$\frac{1}{2}$ INCH FOR THE $2\frac{1}{2}$ - 6 INCH TRADE SIZES

SB0911

Table 13.2
Diameters of limit gauges for throats of bushings

Trade size of conduit, inches	Diameter of go gauge, D_g		Diameter of no-go gauge,	
	inches ^a	(mm)	inches ^a	(mm) D_n
3/8	0.4430	(11.252)	0.4940	(12.548)
1/2	0.5590	(14.199)	0.6230	(15.824)
3/4	0.7410	(18.821)	0.8250	(20.955)
1	0.9430	(23.952)	1.0500	(26.670)
1-1/4	1.2410	(31.521)	1.3810	(35.077)
1-1/2	1.4480	(36.779)	1.6110	(40.919)
2	1.8590	(47.219)	2.0680	(52.527)
2-1/2	2.2210	(56.413)	2.4700	(62.738)
3	2.7600	(70.104)	3.0690	(77.953)
3-1/2	3.1920	(81.077)	3.5490	(90.145)
4	3.6220	(91.999)	4.0270	(102.286)
4-1/2	4.0540	(102.972)	4.5070	(114.478)
5	4.5410	(115.341)	5.0480	(128.219)
6	5.4570	(138.608)	6.0660	(154.076)

^a Tolerances of ± 0.0005 inch (0.013 mm) apply.

13.1.1.6 Clamps or fasteners provided as a part of a box and intended for the attachment of conduit, tubing, or cable shall comply with the performance requirements in the Standard for Fittings for Cable and Conduit, UL 514B. See also 13.1.1.7, 33.5, and 33.6 in this standard.

13.1.1.6 revised November 30, 2001

13.1.1.7 A clamp provided as part of a box and intended for use with nonmetallic-sheathed cable shall secure cable ranging in size from No. 14 AWG (2.1 mm²), two-wire cable with an uninsulated grounding wire to the largest oval or round multiconductor cable that can be accommodated by the clamp unless the clamp is marked to indicate its use with other cable sizes. See 33.7 and 33.8.

13.1.1.8 A clamp provided as part of an outlet box and intended to secure flexible conduit or cable shall effectively close the opening in the box surrounding the cable or conduit.

13.1.1.9 Other than as noted in 13.1.1.10 and 13.1.1.11, a knockout provided in an outlet box for a 1/2-inch or larger trade-size conduit shall be surrounded on both the inside and outside surfaces by a concentric flat surface to permit proper installation of a locknut. The flat surface shall extend in all directions beyond the edge of the knockout for a distance not less than that specified in Table 13.3.

Table 13.3
Diameter of knockout and width of surrounding flat surfaces

Table 13.3 revised December 20, 1999

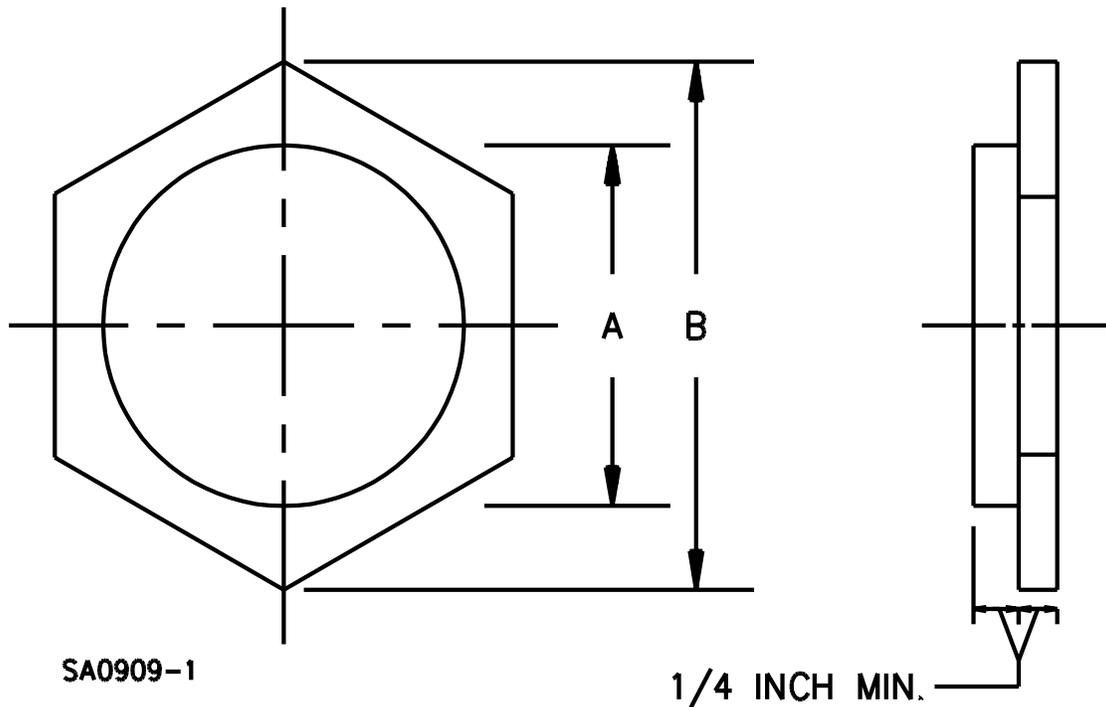
Trade size of conduit, inches	Knockout diameter,		Minimum width of flat surface surrounding knockout,	
	inches ^a	(mm)	inches	(mm)
1/2	0.875	(22.23)	0.133	(3.38)
3/4	1.109	(28.17)	0.156	(3.96)
1	1.375	(34.93)	0.198	(5.03)
1-1/4	1.734	(44.04)	0.274	(6.96)

^a A plus tolerance of 0.031 inch (0.79 mm) and a minus tolerance of 0.015 inch (0.38 mm) applies to the knockout diameter. Knockout diameters will be measured other than at points where a tab may remain after removal of knockout.

13.1.1.10 If the concentric flat surface required by 13.1.1.9 is not provided, the acceptability of the flat surface surrounding a knockout on both the inside and outside surfaces may be determined by application of a test gauge as illustrated in Figure 13.2 and having the dimensions specified in Table 13.4. To use the gauge, the knockout is to be removed and the appropriate trade size of test gauge is to be inserted in the resulting opening from either side of the box. The gauge may be offset from the center of the opening, and it may be rotated so that the flat surface including all points of the hexagonal portion of the gauge will be in intimate contact with the surface of the box. The test gauge is then to be inserted in the opening from the opposite side of the box with the same degree and position of offset from the center used on the other side, and the flat surface including all points of the hexagonal portion of the gauge is to be in intimate contact with the surface of the box as the gauge is rotated through an angle of at least 60 degrees. The test gauge is not to be canted or tilted to make the necessary contact with the surface of the box.

13.1.1.11 A box intended to accommodate a narrow wiring device – see the exception to 9.1 – and having an internal width less than 1.152 inch (29.26 mm) need not comply with the requirement in 13.1.1.9 if the box is intended for use only with nonmetallic-sheathed cable or flexible nonmetallic tubing, and if the internal width is such that the proper connection of those wiring systems can be demonstrated.

Figure 13.2
Dimensions of test gauges for flat surfaces surrounding knockout



13.1.1.12 When judging a box for compliance with the requirement in 13.1.1.9, consideration is to be given to the clearances from adjacent knockouts, box sides, and the like, but it is not necessary that a box be constructed so that conduit can be installed simultaneously in adjacent knockouts.

13.1.2 Wet and damp locations

13.1.2.1 A hole for conduit shall be threaded unless an integral threadless fitting or an acceptable factory-assembled threadless fitting is provided.

13.1.2.2 A bushed hole for open wiring shall not be located in the top or back of a box unless a hood is provided. If such a hole is located in a side or under a hood, the hole and the hood shall be formed to direct a wire leaving the enclosure downward. There shall be provision for drainage in a box containing a knockout, an unthreaded hole, or a bushed hole for open wiring.

13.2 Covers

13.2.1 A hole in a box cover intended to permit the passage of flexible cord shall have a smooth, rounded surface upon which the cord may bear, or shall be provided with an insulating bushing.

Table 13.4
Dimensions of test gauges for flat surfaces surrounding knockout

Trade size of conduit, inches	Nominal knockout diameter, inches (mm)		Dimension A		Dimension B	
			Nominal diameter of conduit, inches (mm) ^a		Maximum diameter of locknut, inches (mm) ^b	
1/2	0.875	(22.23)	0.840	(21.34)	1.140	(28.96)
3/4	1.109	(28.17)	1.050	(26.67)	1.420	(36.07)
1	1.375	(34.93)	1.315	(33.40)	1.770	(44.96)
1-1/4	0.734	(44.04)	1.660	(42.16)	2.281	(57.94)

^a Nominal outside diameter of rigid conduit. Tolerances for test gauge; ± 0.001 inch (0.03 mm).
^b Maximum diameter of locknut. Tolerances for test gauge; plus 0.001 inch, minus 0.000 inch.

13.2.2 If a hole or holes in a cover are intended for use with wires other than flexible cord, there shall be a separate hole for each wire; each hole shall be equipped with a nonabsorptive, insulating bushing.

Exception: The insulating bushing may be omitted in a cover intended for the support of a wiring device.

14 Supports

14.1 Boxes

14.1.1 A box shall be provided with means for support so that it can be fastened securely in place without depending upon the support furnished by any wiring system.

Exception: A means for support need not be provided for:

- a) A box intended for installation in concrete;*
- b) A cast-metal box having a flat back in which mounting-screw holes may be drilled; or*
- c) A conduit body with an internal volume of 100 cubic inches (1639 cm³) or less.*

14.1.2 Sheet-steel end-supporting ears furnished with a box shall not be less than 0.036 inch (0.91 mm) thick if formed from uncoated stock, and not less than 0.039 inch (0.99 mm) thick if formed from galvanized stock. The ears shall be attached to the box and prevented from turning relative to the box. Screws used to attach the ears to a box shall not be smaller than No. 6 and shall not have more than 32 threads per inch. The method of attaching adjustable ears to a box shall permit the box to be mounted with its front flush with the supporting surface, and with its front 1/2 inch (12.7 mm) and shorter distances in front of that surface.

14.1.3 Provision for the supporting of a device to be enclosed in a box shall be independent of the screws used to support the box.

14.1.4 A supporting-nail hole in a box shall be located so that no part of the nail shank will be more than 1/4 inch (6.4 mm) from the interior surface of the back or ends of the box when the box is installed with the nail passing through its interior as intended. The following are not considered to be supporting-nail holes:

- a) A hole that is 0.120 inch (3.05 mm) or smaller in diameter.
- b) Holes that are located so that a 0.120 inch drill rod cannot be inserted through both walls.

Exception: A supporting-nail hole that is larger than 0.120 inch in diameter may be located in the side of an outlet box that has face dimensions of at least 3 by 3 inches (76.2 by 76.2 mm).

14.1.5 The supporting means of a box intended to be installed in a finished structure shall comply with the requirements in 26.4.1 – 26.4.5. When the supporting means is constructed of a polymeric material, it shall also comply with Polymeric Supporting Means, Section 26.5.

14.1.5 revised December 20, 1999

14.1.6 An outlet box intended for fixture support, intended to be installed in an unfinished construction, and marked in accordance with 33.14 shall comply with Fixture Support, Section 26.2.

14.1.6 added December 20, 1999

14.1.7 A box intended to be installed in a finished structure or unfinished construction and marked for support of a product weighing more than 6 pounds (2.7 kg) and 15 pounds (6.8 kg) or less shall comply with 14.1.9.

Added 14.1.7 effective December 20, 2001

14.1.8 A box intended to be installed in a finished structure or unfinished construction and marked for support of a product weighing more than 15 pounds (6.8 kg) and 49 pounds (22.2 kg) or less shall comply with 14.1.10, and be provided with installation instructions in accordance with 34.3.

Added 14.1.8 effective December 20, 2001

14.1.9 A box marked for use in a wall in accordance with 33.23 shall comply with 26.4.1 – 26.4A.2. An outlet box marked for use in a ceiling in accordance with 33.23 shall comply with 26.4A.3. An outlet box marked for use in a wall and ceiling in accordance with 33.23 shall comply with 26.4.1 – 26.4A.3.

Exception: A box for use in unfinished construction is not required to comply with 26.4.1 – 26.4.5.

Revised 14.1.9 effective December 20, 2001

14.1.10 A box marked for use in a wall in accordance with 33.24 shall comply with 26.4.1 – 26.4A.2. An outlet box marked for use in a ceiling in accordance with 33.24 shall comply with 26.4A.3. An outlet box marked for use in a wall and ceiling in accordance with 33.24 shall comply with 26.4.1 – 26.4A.3.

Exception: A box for use in unfinished construction is not required to comply with 26.4.1 – 26.4.5.

Revised 14.1.10 effective December 20, 2001

14.1.11 A floor box intended to be installed in a wood support structure or raised floor structure shall comply with Support for Floor Boxes, Section 26.6. The box shall be provided with installation instructions indicating the type of floor structure in which the box is intended to be installed.

Added 14.1.11 effective December 20, 2001

No Text on This Page

14.2 Conduit bodies

14.2.1 A conduit body having a volume exceeding 100 cubic inches (1639 cm³) and a conduit body having provision for not more than two conduit entries shall have no provision for mounting of a switch, fuseholder, or other control device. See 14.1.3.

Exception: A conduit body having a volume of 100 cubic inches or less and having less than three conduit entries may have provision for mounting a wiring device if the conduit body is marked in accordance with 33.11 and the volume is verified in accordance with Dimensions, Section 9.

15 Studs

15.1 A fixture stud shall have available no fewer than five full threads and shall be made of malleable iron, steel, or other acceptable material.

16 Grounding

16.1 A box intended for connection to metal raceway or metal-enclosed cable shall provide a continuous electrical grounding connection. All exposed parts of a box or cover shall be in electrical connection with the means for grounding.

Exception: A part that does not enclose wiring need not be in electrical connection with the grounding means.

16.2 A box shall have a tapped hole for a No. 10-32 grounding screw.

Exception No. 1: A box having a tapped hole for a grounding screw other than a No. 10-32 screw and marked in accordance with 33.9 meets the intent of this requirement.

Exception No. 2: A tapped hole is not required for a box having fastening means such as an attached wire connector or clip, or a self-threading or factory-assembled screw that is identified for the purpose of securing the grounding conductor.

16.2 revised December 20, 1999

16.3 A grounding screw provided in a box shall:

- a) Be No. 8-32 or larger;
- b) Have a green-colored head that is slotted or hexagonal, or both; and
- c) Be plated steel, stainless steel, copper, or copper alloy.

Only a plated steel or stainless steel grounding screw shall be provided in an aluminum box. A grounding screw shall engage at least two full threads and shall be used in conjunction with upturned lugs, a cupped washer, or an equivalent method that is capable of retaining a No. 10 AWG conductor under the head of the screw.

16.4 With respect to the requirement in 16.3, a grounding wire provided in lieu of a grounding screw shall be either solid copper not smaller than No. 14 AWG (2.1 mm²) or solid aluminum not smaller than No. 12 AWG (3.3 mm²), and shall be 5 – 6 inches (127 – 152 mm) long.

16.5 One end of a grounding wire shall be secured to the box by welding or by means of a copper, a copper alloy, or a stainless steel rivet if the wire is copper, or by means of an aluminum or stainless steel rivet if the wire is aluminum. If insulated, the insulation shall be rated for 600 volts and the color of the surface of the insulation shall be green, with or without one or more yellow stripes.

Exception: A screw may be used to secure the grounding wire in the box if the screw complies with the requirements in 16.3.

16.6 A box with removable sides, such as a flush-device box intended for ganging in the field, shall be constructed so that the electrical bond between separable parts involves at least one threaded screw connection.

16.7 A cast-metal floor box shall be provided with either a grounding screw or a grounding lead in accordance with 16.3 or 16.4, respectively.

Exception: A cast-metal floor box having grounding continuity in accordance with 16.8 between the box and the device intended to be mounted in the box need not be provided with a grounding screw or grounding lead.

16.8 With reference to the Exception to 16.7, a cast-metal floor box in which a device is intended to be installed so that there is a direct metal-to-metal screw-tightened connection between the intended device and the box has grounding continuity and complies with 16.7. Other connections, including those relying on a friction fit, shall comply with Resistance Test, Section 32A.4.

16.8 revised December 20, 1999

17 Wet and Damp Locations Use

17.1 All parts required to comply with the applicable requirements in Wet and Damp Locations Test, Section 29, shall be provided in a single unit carton with installation and assembly instructions.

Exception: A part such as a box, a cover, or a wiring device and installation material such as sealing compound may be separately shipped or recommended when:

a) The part required to complete the assembly or the recommended sealing compound is clearly and specifically identified in the installation instructions, and

b) A gasket that is depended upon to exclude water from the installed assembly is provided with the cover or the flush-device cover plate.

17.1 revised June 4, 2001

17.2 A cover or a flush-device cover plate intended for use with a wiring device that requires modification for assembly or that is a nonstandard size or shape shall be provided with the wiring device and gasket, if required, in the same unit carton. Any modifications of the wiring device shall be completed before shipment.

17.3 An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate intended for use in a wet location with the cover closed shall have a self-closing cover or the equivalent.

17.4 A cover or a flush-device cover plate for a receptacle shall not prevent complete seating of an attachment plug having dimensions as specified in Table 29.1 with the face of the receptacle.

17.5 An opening for a receptacle shall accommodate a receptacle of a standard size, and shall locate the face of the receptacle at least 0.015 inch (3.8 mm) outside the outer plane of the opening in a cover.

18 Ceiling-Suspended Fan Support

18.1 In addition to the requirements for metallic outlet boxes in this Standard, an outlet box intended to support a ceiling-suspended fan shall:

a) Be provided with a minimum of two steel No. 8-32 or No. 10-32 cover retaining or fan mounting screws and matching threaded or unthreaded holes. When No. 10-32 screws are provided, the box shall be marked in accordance with 33.22. When unthreaded holes are provided, the box shall be provided with:

- 1) Screws of the thread cutting type; or
- 2) A screw and nut assembly for use with clearance holes.

Locking type washers or locknuts are to be utilized only when required by the installation instructions. For a screw and nut assembly, the screws shall be held such that they do not rotate.

- b) Comply with the support tests in 26.2.1 – 26.3.5.
- c) Be marked in accordance with 33.16 or 33.16A, whichever applies.
- d) Be provided with installation instructions in accordance with 34.2.

Revised 18.1 effective December 20, 2001

18.2 A screw intended to secure a ceiling-suspended fan mounting bracket to an outlet box (in accordance with 18.1(a)) shall not have more than 9/16 inches (14.3 mm) of exposed screw threads when a 1/8-inch (3.2-mm) thick bracket is secured to the box.

Exception: A screw with more than 9/16 inches of exposed threads meets the intent of the requirement where a means is provided to reduce the risk of contact between the screw threads and the wire insulation.

18.2 revised December 20, 1999

19 Partitions

19.1 A partition shall fit the inside of the box in which it is intended to be used. Any openings or gaps of any length between the partition and the inside surface of the box shall not be greater than 0.080 inch (2.0 mm).

Effective date for 19.1 changed from February 2, 1998 to December 15, 1998

19.2 A polymeric material used for a partition shall have a relative thermal index of not less than 80°C (176°F) for properties of electrical and mechanical without impact determined in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

19.2 revised June 4, 2001

19.3 A polymeric material used for a partition shall comply with the flammability requirements for box materials in the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

Exception: A material designated 5VA, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, need not be tested.

Effective date for 19.3 changed from February 2, 1998 to December 15, 1998

19.4 A polymeric material used for a partition shall comply with the mold stress requirements for boxes in the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

Effective date for 19.4 changed from February 2, 1998 to December 15, 1998

19.5 A polymeric material used for a partition shall comply with the water absorption requirements for boxes in the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

Effective date for 19.5 changed from February 2, 1998 to December 15, 1998

19.6 A polymeric material used for a partition shall not ignite within 15 seconds after application of the test current, when subjected to the Hot-Wire Ignition Test, in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

Exception: A polymeric material with a Performance Level Category (PLC) of 0, 1, 2, or 3 in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, need not be tested.

Effective date for 19.6 changed from February 2, 1998 to December 15, 1998

PERFORMANCE

20 General

20.1 Unless otherwise stated, no fewer than six samples of each type of box, box cover, or flush-device cover are to be subjected to each test, except that if a line of at least four boxes or covers of a particular design is being investigated, no fewer than three samples of each line are to be tested.

21 Metallic-Coating-Thickness Test

21.1 Except as specified in 21.2, the metallic-coating-thickness test described in 21.3 – 21.10 shall be used to determine the thickness of a zinc or cadmium coating. The test is only to be conducted when a required coating thickness is specified.

21.2 When agreeable to those concerned, a nondestructive test method is useable to determine the thickness of a zinc or cadmium coating. For referee measurements, the test described in 21.3 – 21.10 is to be used.

21.2 revised December 20, 1999

21.3 The solution used for the test is to be made from distilled water and is to contain 200 grams per liter of American Chemical Society (ACS) reagent grade chromic acid (CrO_3) and 50 grams per liter of ACS reagent grade concentrated sulfuric acid (H_2SO_4). The latter is equivalent to 27 milliliters per liter of reagent grade concentrated sulphuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4 .

21.4 The test solution is to be contained in a glass vessel such as a separatory funnel with the outlet equipped with a stopcock and a capillary tube having an inside bore of 0.025-inch (0.64-mm) and a length of 5.5 inches (140 mm). The lower end of the capillary tube is to be tapered to form a tip, the drops from which are about 0.05 milliliter each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that, when the stopcock is open, the rate of dropping is 100 ± 5 drops per minute. An additional stopcock may be used in place of the glass tube to control the rate of dropping.

21.5 The sample and the test solution are to be kept in the test room long enough to acquire the temperature of the room, which is to be noted and recorded. The test is to be conducted at an ambient temperature of $70.0 - 90.0^\circ\text{F}$ ($21.1 - 32.2^\circ\text{C}$).

21.6 Each sample is to be cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed completely by means of solvents. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. Care is to be exercised to avoid contact of the cleaned surface with the hands or any foreign matter.

21.7 The sample to be tested is to be supported 0.7 – 1.0 inch (17.8 – 25.4 mm) below the orifice, so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested is to be inclined about 45 degrees from horizontal.

21.8 After cleaning, the sample to be tested is to be put in place under the orifice. The stopcock is to be opened and the time in seconds is to be measured until the dropping solution dissolves the protective metallic coating, exposing the base metal. The end point is the first appearance of the base metal recognizable by the change in color.

21.9 Each sample of a test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces on the inside surface and at an equal number of points on the outside surface, at places where the metallic coating may be expected to be the thinnest. On boxes made from precoated sheets, the external corners that are subjected to the greatest deformation are likely to have thin coatings.

21.10 To calculate the thickness in inches (mm) of the coating being tested, select from Table 21.1 the thickness factor appropriate for the temperature at which the test was conducted, multiply by 0.00001 inch (0.003 mm), and then multiply by the time in seconds required to expose the base metal as measured in 21.8.

Table 21.1
Coating thickness factors

Temperature, degrees F (C)		Thickness factors,	
		Cadmium platings	Zinc platings
70	(21.1)	1.331	0.980
71	(21.7)	1.340	0.990
72	(22.2)	1.352	1.000
73	(22.8)	1.362	1.010
74	(23.3)	1.372	1.015
75	(23.9)	1.383	1.025
76	(24.4)	1.395	1.033
77	(25.0)	1.405	1.042
78	(25.6)	1.416	1.050
79	(26.1)	1.427	1.060
80	(26.7)	1.438	1.070
81	(27.2)	1.450	1.080
82	(27.8)	1.460	1.085
83	(28.3)	1.470	1.095
84	(28.9)	1.480	1.100
85	(29.4)	1.490	1.110
86	(30.0)	1.501	1.120
87	(30.6)	1.513	1.130
88	(31.1)	1.524	1.141
89	(31.7)	1.534	1.150
90	(32.2)	1.546	1.160

22 Tests on Alternate Corrosion Protection Systems

22.1 General

22.1.1 A coating other than zinc, cadmium, or paint that is intended for use in wet locations shall comply with the requirements in 22.1.3 – 22.5.3. A coating other than zinc, cadmium, or paint that is not intended for use in wet locations shall comply with the requirements in 22.1.3 – 22.2.1 and 22.4.1 – 22.5.3.

22.1.1 revised November 30, 2001

22.1.2 A paint coating that is intended for use in wet locations shall comply with the Salt-Spray (Fog) Test, the Moist Carbon Dioxide-Sulfur Dioxide Test, and the Light and Water Test for Clear Coatings in accordance with the Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332, after being conditioned in accordance with 22.2.1. A paint coating that is not intended for use in wet locations shall comply with the Salt-Spray (Fog) Test and the Moist Carbon Dioxide-Sulfur Dioxide Test in accordance with UL 1332 after being conditioned in accordance with 22.2.1.

22.1.3 Fifty specimens of 4 by 12 inch (100 by 300 mm) steel panels are to be provided with the corrosion protection system. The specimens may be of any convenient thickness. If the steel panels cannot be produced, the specimens may be of the finished product. Thirty specimens are to be tested. The additional specimens are to be used in case of damage to the original samples during preparation or handling.

22.1.4 The edges or bare surfaces of all panels or finished products are to be covered with moisture-resistant tape or compound. Half of the specimens to be exposed are to be scribed in accordance with the Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments, ASTM D1654-92. The specimens are to be free of grease or dirt. The coating thickness of each specimen is to be measured prior to exposing them to the test environments.

22.2 Air oven conditioning exposure

22.2.1 Six scribed and six unscribed specimens of each coating system are to be conditioned for 240 hours at a temperature of $87 \pm 1^\circ\text{C}$ ($189 \pm 2^\circ\text{F}$) in an air-circulating oven. These specimens are to be used for the Resistance to Salt Spray (Fog) and Resistance to Moist Carbon Dioxide-Sulfur Dioxide-Air Tests.

22.3 Resistance to ultraviolet light and water

22.3.1 Three scribed and three unscribed specimens are to be exposed to ultraviolet light and water by either method specified in 22.3.3 or 22.3.4.

22.3.2 As a result of the exposure, the unscribed specimens shall show no base metal corrosion nor any blisters. For the scribed specimens, the average creeping distance of corrosion products from the scribe is not to be greater than Rating No. 6 [$1/16 - 1/8$ inch ($1.6 - 3.2$ mm)] as designated in Procedure A, Method 2 of ASTM D1654-92, with maximum isolated spot not exceeding $3/8$ inch (9.5 mm). There shall be no visual evidence of pitting of the substrate and only the beginning of a buildup of corrosion products beneath the coating uplifted from the scribe.

22.3.3 For twin enclosed carbon-arc, the specimens are to be exposed for 360 hours to light and water in accordance with ASTM G 23-93 using the apparatus designated as type DH. Method 1, continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 120 minutes consisting of a 102 minute light exposure and an 18 minute exposure to water spray with light, is to be used. The apparatus is to operate with a black-panel temperature of $63 \pm 3^\circ\text{C}$ ($145 \pm 5^\circ\text{F}$).

22.3.4 For xenon-arc, the specimens are to be exposed for 500 hours to light and water in accordance with ASTM G 26-93 using the apparatus designated as type BH. Test Method A, continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 120 minutes consisting of a 102 minute light exposure and an 18 minute exposure to water spray with light, is to be used. The apparatus is to operate with a 6500 W, water-cooled xenon-arc lamp, borosilicate glass inner and outer optical filters, a spectral irradiance of $0.35 \text{ W/m}^2/\text{nm}$ at 340 nm and a black-panel temperature of $63 \pm 3^\circ\text{C}$ ($145 \pm 5^\circ\text{F}$).

22.4 Resistance to salt spray (fog)

22.4.1 Six as-received and six air-oven conditioned specimens are to be exposed to the salt spray (fog) for 600 hours in accordance with the Standard Method of Salt-Spray (Fog) Testing, ASTM B117-94. Three of the as-received and three of the air-oven conditioned specimens are to be scribed, as described in 22.1.4.

22.4.2 As a result of the conditioning, the unscribed specimens shall show no more than a light corrosion beneath the coating system with no visual pitting of the substrate and only the beginning of a buildup or weeping of corrosion products. For the scribed specimens, the average creeping distance of corrosion products from the scribe shall not be greater than Rating No. 5 [$1/8 - 3/16$ inch (3.2 – 4.8 mm)] as designated in Procedure A, Method 2 of ASTM D1654-92, with maximum isolated spot not exceeding $3/8$ inch (9.5 mm).

22.5 Resistance to moist carbon dioxide-sulfur dioxide-air

22.5.1 Six as-received and six air-oven conditioned specimens are to be exposed to the moist carbon dioxide-sulfur dioxide-air for 1200 hours. The apparatus used for this exposure is to consist of a chamber having a volume of at least 3 cubic feet with a water jacket and thermostatically controlled heater to maintain a temperature of $35 \pm 2^\circ\text{C}$ ($95 \pm 3^\circ\text{F}$). Three of the as-received and three of the air-oven conditioned specimens are to be scribed as described in 22.1.4.

22.5.2 As a result of the conditioning, the unscribed specimens shall show no more than a light corrosion beneath the coating system with no visual pitting of the substrate and only the beginning of a buildup or weeping of corrosion products. For the scribed specimens, the average creeping distance of corrosion products from the scribe shall not be greater than Rating No. 6 [$1/16 - 1/8$ inch (1.6 – 3.2 mm)] as designated in Procedure A, Method 2 of ASTM D1654-92, with maximum isolated spot not exceeding $3/8$ inch (9.5 mm).

22.5.3 The carbon dioxide and sulfur dioxide are to be supplied to the test chamber from commercial cylinders containing the gases under pressure. An amount of carbon dioxide equivalent to 1 percent of the volume of the test chamber and an equal volume of sulfur dioxide is to be introduced into the chamber each working day. Prior to introducing the new charge of gas each day, the remaining gas-air mixture from the previous day is to be purged from the chamber. A small amount of water is to be maintained at the bottom of the chamber for humidity. This water is not to be changed during the exposure. The specimens are to be supported in plastic racks at an angle of 15 degrees from the vertical.

23 Volume Verification Test

23.1 A box, partitioned section, raised cover, extension cover, or fitting shall hold a volume of water equal to or greater than the marked volume when tested in accordance with 23.2 – 23.5.

23.2 All cable clamps, fixture studs, grounding pigtailed, internal screws, and other internal accessories are to be removed. Any projections that extend outside the plane of the open face of a box, such as ears for mounting a cover or a flush device, are to be ground flush with the face of the box.

23.3 All large openings are to be closed by flat, rigid plates clamped in place across the openings. One of the plates is to contain two small holes, one for the entrance of a measuring fluid, the other for venting air.

23.4 Using modeling clay, putty, glazing compound, or similar material:

- a) A hole through the side or bottom of the sample and a hole between the sample and the plate mentioned in 23.3 are to be filled flush with the inside surface.
- b) An internal hub, if tapped through, is to be filled flush with the end of the hub.
- c) A bushed opening is to be filled flush with the conduit stop.

23.5 A clean, graduated vessel (pipette or the equivalent) having a volume equal to or greater than the marked volume of the test sample is to be filled with water at room temperature. The water is then to be transferred from the vessel to the test sample through the hole in the plate mentioned in 23.3.

24 Test on Knockouts

24.1 All knockouts

24.1.1 When tested in accordance with 24.1.2, the knockout shall remain in place and the clearance between the knockout and the opening shall not be more than 0.010 inch (0.25 mm) when measured 1 hour after the force has been removed.

24.1.2 A force of 10 pounds is to be applied to a knockout for 1 minute by means of a 1/4 inch (6.4 mm) diameter mandrel with a flat end. The force is to be applied in a direction perpendicular to the plane of the knockout and at the point most likely to cause movement. If a box is provided with a concentric or eccentric knockout, the force is to be applied to the smallest knockout.

24.2 Concentric and eccentric knockouts

24.2.1 A box provided with a concentric or eccentric knockout shall carry the specified current for the time indicated in Table 24.1. As a result of the application of the current, the outer knockout shall remain in place, and there shall be continuity between the box and raceway. Arcing and burning during the test is acceptable.

Effective date for 24.2.1 changed from February 2, 1998 to December 15, 1998

Table 24.1
Test currents and times

Effective date for Table 24.1 changed from February 2, 1998 to December 15, 1998

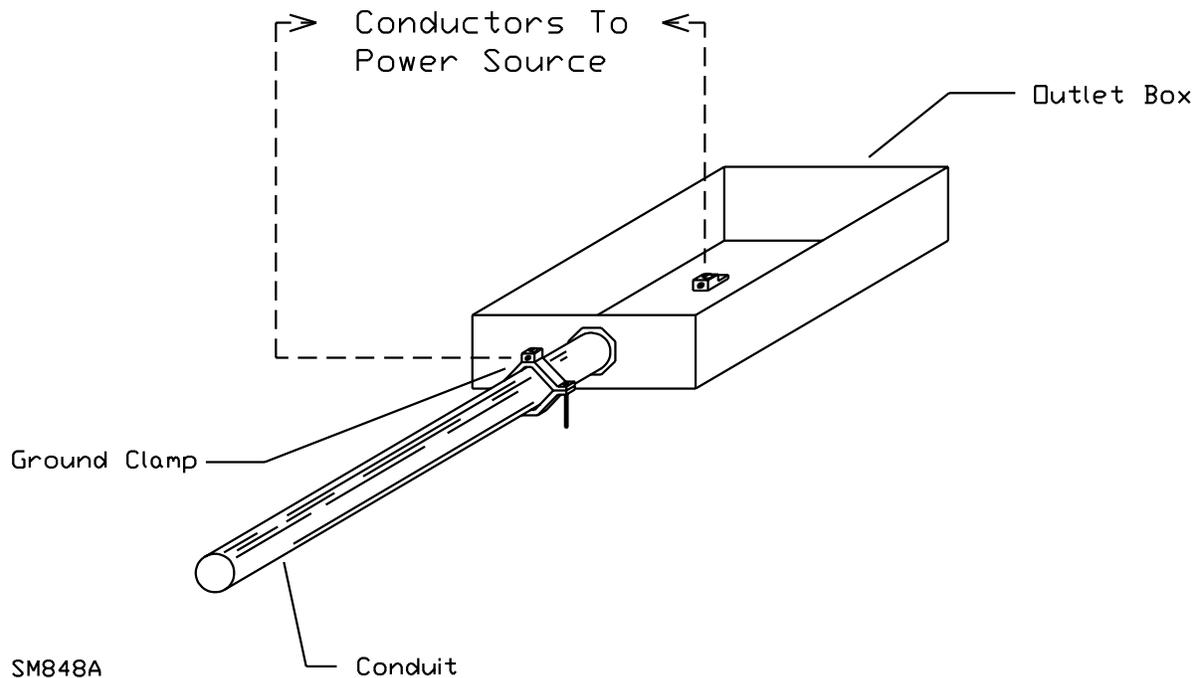
Trade size of smallest knockout, inch	Test time, seconds	Current, amperes	Minimum size of copper leads used to connect sample assembly to current source,	
			AWG	(mm ²)
1/2	4	1180	8	(8.4)
3/4, 1	6	1530	6	(13.3)

24.2.2 One sample of each trade size concentric or eccentric knockout is to be tested. The box is to be assembled to a minimum 6 inch (152 mm) length of rigid metal conduit as shown in Figure 24.1.

Effective date for 24.2.2 changed from February 2, 1998 to December 15, 1998

Figure 24.1
Current test

Effective date for Figure 24.1 changed from February 2, 1998 to December 15, 1998



24.2.3 One locknut is to be reversed and threaded on the conduit. The smallest knockout is to be removed and the raceway is to be assembled to the box using a second locknut, inside of the box. The locknut is to be hand-tightened and then further tightened 1/4 turn with a hammer and a standard screwdriver or by an equivalent method. A copper wire lead is to be connected to:

- a) The box by a pressure wire connector; and
- b) The raceway by a ground clamp of the appropriate size, 1/2 inch (12.7 mm) from the locknut.

Pressure wire connectors are to be tightened using the torque specified in the Standard for Wire Connectors and Soldering Lugs, UL 486A. The test current is to be passed through the assembly.

Effective date for 24.2.3 changed from February 2, 1998 to December 15, 1998

24.2.4 After having carried the current, continuity shall exist between the parts of the test assembly when measured between a point on the raceway and a point on the box, 1/4 inch (6.4 mm) from the knockout. Any indicating device, such as an ohmmeter or battery-and-buzzer combination may be used to determine whether continuity exists.

Effective date for 24.2.4 changed from February 2, 1998 to December 15, 1998

24.2.5 A box provided with a multiple concentric or eccentric ring knockout is to be tested in accordance with 24.2.1 – 24.2.4 with the smallest part of the knockout removed and then again with the next to largest knockout ring removed.

Effective date for 24.2.5 changed from February 2, 1998 to December 15, 1998

25 Tests on Closures

25.1 A nonmetallic closure shall maintain the integrity of the enclosure in which it is installed when subjected to the flame test described in the Standard for Fittings for Cable and Conduit, UL 514B.

Exception: A phenolic closure need not be tested.

25.1 revised November 30, 2001

25.2 A nonmetallic plug or other closure intended to be assembled to a sheet-metal box without a locknut shall not be damaged or its effectiveness impaired when installed in each of the surfaces mentioned in 25.4.

25.3 No fewer than 18 samples of each plug or other closure are to be tested as specified in 25.2. No fewer than six of these samples are to be in each of the following conditions for test:

- a) As received,
- b) At room temperature after exposure for 168 hours to circulating air at a temperature of $90.0 \pm 1.0^{\circ}\text{C}$ ($194.0 \pm 1.8^{\circ}\text{F}$), and
- c) Immediately after exposure for 24 hours to a temperature of $\text{minus } 20.0 \pm 1.0^{\circ}\text{C}$ ($\text{minus } 4.0 \pm 1.8^{\circ}\text{F}$).

25.4 The various types of surface mentioned in 25.2 include plated, painted, and enameled steel, 0.026 – 0.075 inch (0.66 – 1.91 mm) thick, and aluminum 0.032 – 0.091 inch (0.81 – 2.31 mm) thick.

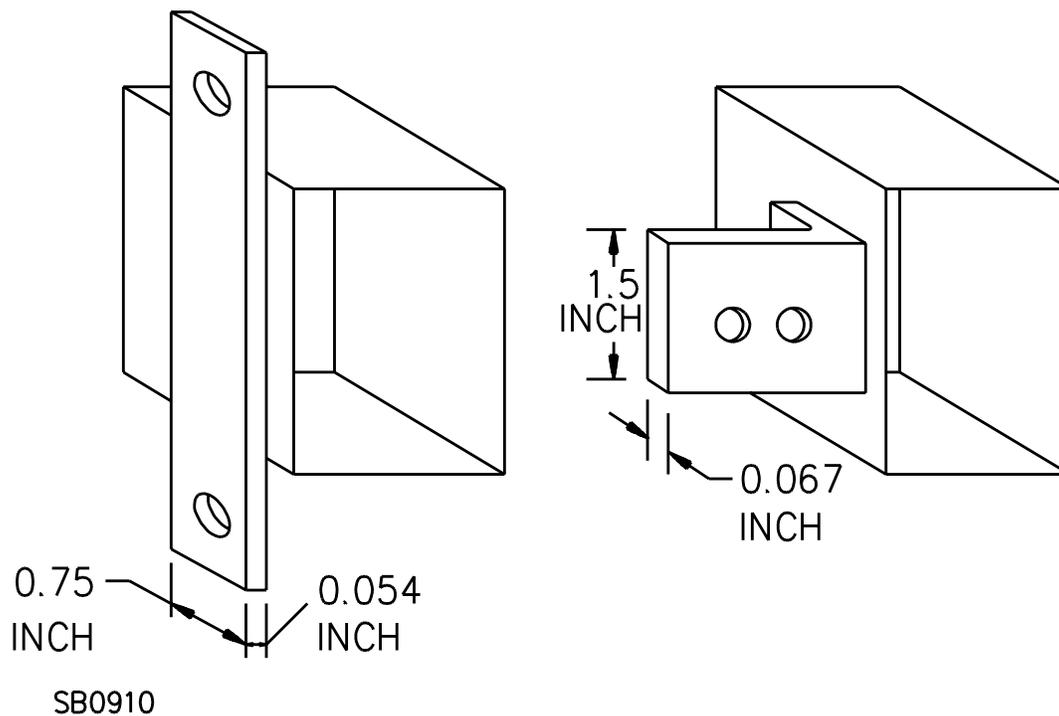
26 Tests on Supports

26.1 General

26.1.1 Other than as noted in 26.1.2, a bracket or other device for securing a flush-device or other box not intended to support a fixture to a structural wall stud shall withstand a pull of 50 pounds (222 N) for 5 minutes. The bracket may bend but it shall not break, and the box shall not be pulled loose from the bracket.

26.1.2 The test required by 26.1.1 may be omitted if the bracket is of steel and has dimensions not less than those shown in Figure 26.1 for a bracket of corresponding type, and if the bracket is secured to the box by not less than two rivets, spot-welds, or the equivalent. A steel bracket is to be protected against corrosion in accordance with Protection Against Corrosion, Section 7.

Figure 26.1
Dimensions of bracket



26.1.3 The bracket is to be secured so that the plane of the front of the box is vertical, and a 50-pound (22.7-kg) weight is to be suspended from the lower end of the box.

26.2 Fixture support

26.2.1 As a result of the test specified in 26.2.3, the supporting device shall not break and the box shall not be pulled loose from the supporting device. Bending of the supporting device without breaking or pulling loose from the box complies with the requirement.

Revised 26.2.1 effective December 20, 2001

26.2.2 The test specified in 26.2.3 is to be performed on the following:

- a) A bar hanger.

Exception: The requirement does not apply to a bar hanger made of 3/16 by 1/2 inch (4.8 by 12.7 mm) or larger steel bar stock when the hanger is not provided as part of a box or with means for attachment to a box.

- b) A device other than a bar hanger when the device, or the smallest unit carton in which the device is packed is marked to indicate the device is for fixture support.
- c) A box provided with a fixture stud or other means for the support of a fixture.

Revised 26.2.2 effective December 20, 2001

26.2.3 The box-supporting device is to be mounted rigidly so as to support, in the intended manner, an outlet box to which a vertical downward force is imparted, and the pull force corresponding to the fixture weight in Table 26.1 is to be applied to the box for 5 minutes. When a fixture stud or other means for support is provided with a box, the pull force is to be directly applied to that means for support. See 26.2.2(c).

Revised 26.2.3 effective December 20, 2001

Table 26.1
Fixture support test pull forces

Added Table 26.1 effective December 20, 2001

Weight of fixture ^a		Pull force ^b	
lb	(kg)	lb	(N)
50 ^c	(22.7)	200	(890)
70	(31.7)	280	(1246)
90	(40.8)	360	(1601)
110	(49.9)	440	(1957)
130	(59.0)	520	(2313)

^aThe weight of the fixture is to be determined by the marking required in 33.26. There is no limit on the weight of the fixture.
^bThe pull force that corresponds with the marked fixture weight is to be used for the test specified in 26.2.3.
^cFor a fixture weighing 50 lbs (22.7 kg) or less, a 200 lb (890 N) pull force is to be used.
NOTE – Values for fixtures exceeding 130 lb (59.0 kg) not shown in the table are to be extrapolated using 20-lb increments for the fixture weight and 80-lb increments for the corresponding pull force values.

26.3 Ceiling-suspended fan support

26.3.1 An outlet box intended to support a ceiling-suspended fan (see 18.1) shall comply with the requirements for fixture support in 26.2.1 – 26.2.3. Additionally, as a result of the test specified in 26.3.2 – 26.3.5, there shall be no cracking, crazing, breaking, or visible damage to the outlet box, mounting ears, or box supporting system (other than bending), and there shall be no stripping of threads in the outlet box or box supporting system. The box or supporting system shall not be pulled loose from the test structure. One sample is to be tested in each of the horizontal and inclined positions.

26.3.2 An outlet box is to be mounted in accordance with the manufacturer's installation instructions (see 34.2) to a supporting test structure so as to be tested while both in:

- a) Horizontal position; and
- b) Inclined 30 degrees from the horizontal with the mounting screws perpendicular to the ceiling and the fan blades parallel to the floor. See Figure 26.2.

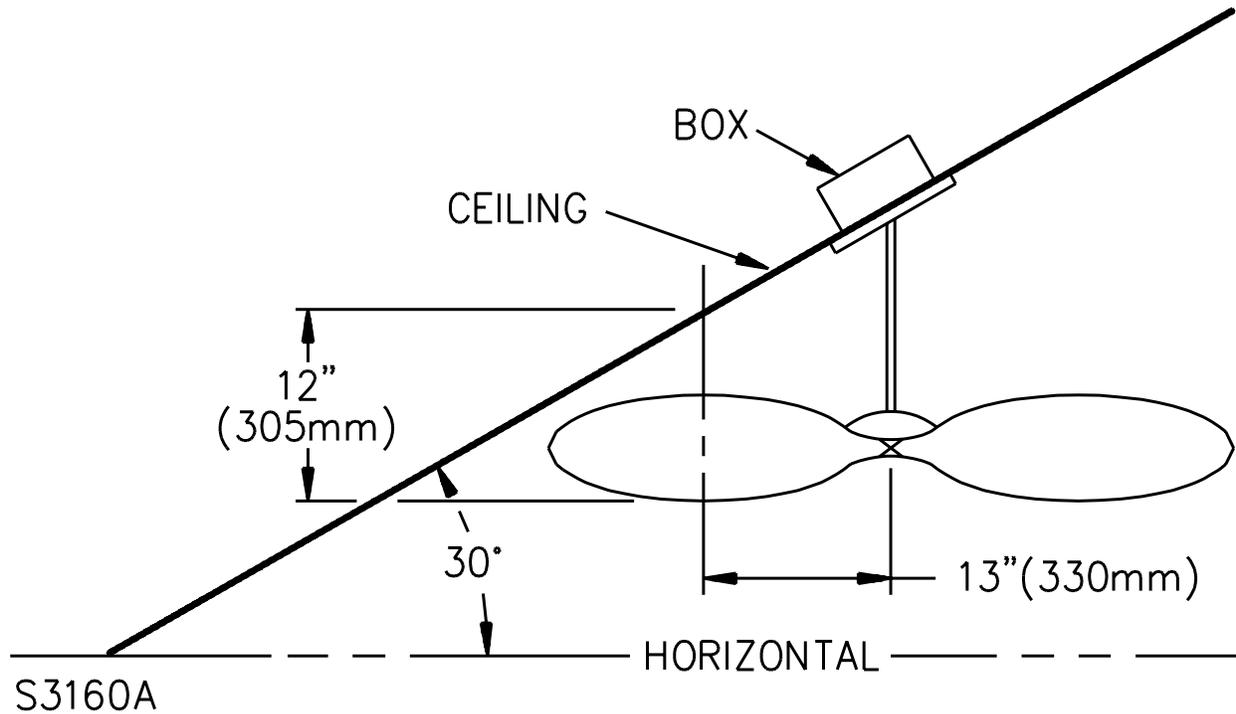
26.3.2 revised December 20, 1999

26.3.2A An outlet box is to be subjected to the tests specified in 26.3.3 – 26.3.5 using:

- a) A fan weighing 35 pounds (15.9 kg) for a box marked in accordance with 33.16, or
- b) A fan weighing 50 pounds (22.7 kg) for a box marked in accordance with 33.16A.
- c) A fan weighing 70 pounds (31.7 kg) for a box marked in accordance with 33.16B.

Added 26.3.2A effective December 20, 2001

Figure 26.2
Inclined ceiling test



26.3.3 A 52 ± 1 inch (1320 ± 25 mm) diameter test fan, having four blades, is to be used for the tests. A 40-gram (1.4-ounce) imbalance is to be placed at 15-1/4 inches (400 mm) from the center of the motor shaft. The fan is to be provided with a downrod of rigid metal pipe of a length to position the lower edge of the fan blades 12 ± 1 inches (305 ± 25 mm) below the surface of the ceiling after mounting. The downrod is to be welded at the upper end to a 5/16 inch (7.9 mm) thick fan mounting bracket. The fan mounting bracket is to be secured to the outlet box in accordance with the outlet box installation instructions. No. 8-32 screws or nuts are to be tightened to 20 pound-inches (2.26 N·m), and No. 10-32 screws or nuts are to be tightened to 35 pound-inches (3.96 N·m). A universal type joint mounting construction is not to be used for the test. The fan motor is to be an adjustable speed type.

Revised 26.3.3 effective December 20, 2001

26.3.4 The fan is to be connected to a variable voltage supply adjusted to maintain a tip speed of 4000 feet (1220 m) per minute (294 rpm). The blade pitch is to be reduced to a minimum. The fan is to be operated continuously at the prescribed speed for 24 hours.

26.3.5 Following testing as described in 26.3.1 – 26.3.4, one of the cover retaining or fan mounting screws or nuts is to be loosened two full turns and the fan is to operate as specified for an additional 24 hours for each mounting condition specified in 26.3.2.

Exception: The screws or nuts shall not be loosened for a construction that employs cover retaining or fan mounting screws with locking type washers or locknuts.

26.4 Boxes intended to be installed in a finished structure

Title of Section 26.4 revised June 4, 2001

26.4.1 As a result of the test described in 26.4.2 – 26.4.5, the box supporting means shall not crack or break or result in the face of the box being permanently displaced more than 1/8 inch (3.2 mm) from the plane of the face of the test surface when measured 1 minute after the test load is removed.

26.4.1 revised December 20, 1999

26.4.2 Eight boxes intended for use in walls or ten boxes intended for use in ceilings are to be installed in a 3/8-inch (9.5-mm) thick plywood sheet, reinforced with a support 6 inches (152 mm) from one edge of the openings for the boxes, or in a finished surface in accordance with the manufacturer's instructions, see 26.4.2A. Screws for the box supporting means are to be tightened in accordance with the manufacturer's instructions. See 34.1. In the absence of instructions, screws larger than No. 8 are to be tightened with a torque of 35 pound-inches (3.96 N·m). A No. 8 screw is to be tightened with a torque of 20 pound-inches (2.26 N·m). A No. 6 screw is to be tightened with a torque of 12 pound-inches (1.36 N·m). See 26.4.4.

26.4.2 revised June 4, 2001

26.4.2A For a product marked in accordance with 34.3, the finished surface that is specified in the manufacturer's instructions shall be used instead of the 3/8-inch (9.5-mm) thick plywood sheet.

26.4.2A added June 4, 2001

26.4.3 Deleted December 20, 1999

26.4.4 Screws for the box mounting means are to be tightened to the torque specified in 26.4.2. A screw that strips before being tightened to the torque specified shall not override more than once. As a result of the test in 26.4.5, the screw shall be capable of being removed by a screwdriver.

26.4.4 revised December 20, 1999

26.4.5 After installation as specified in 26.4.2, a force of 50 pounds (222 N) is to be applied for 5 minutes consecutively to each of two boxes in a direction normal to the plane of the face of the test surface along the center line of the box and tending to push the box into the opening. The same force is to be applied to each of two previously untested boxes, in a direction tending to pull the box out of the opening. Other than a clamp that is an integral part of a box having pryouts or punchouts for armored cable only, a force of 150 pounds (667 N) is to be applied for 5 minutes in a direction perpendicular to the wall of the two remaining boxes at any point where a wiring system is able to be attached. For a clip or clamp that is an integral part of a box intended for use with nonmetallic sheathed cable only, the remaining two samples are to be tested with a force of 60 pounds (267 N) applied to the box wall for 5 minutes at right angles to any pryout or punchout for the cable that applies the greatest stress to the mounting device.

26.4.5 revised December 20, 1999

26.4A Boxes for support of products up to 50 pounds (22.7 kg)

26.4A.1 As a result of the test described in 26.4A.2 – 26.4A.3, the box supporting means shall not crack or break or result in the face of the box being permanently displaced more than 1/8 inch (3.2 mm) from the plane of the face of the test surface when measured 1 minute after the test load is removed.

26.4A.1 added December 20, 1999

26.4A.2 After installation as specified in 26.4.2, a steel bar 1/4 inch (6.4 mm) thick minimum, 1/2 inch (12.7 mm) wide, and 4-1/2 inch (25.4 mm) long is to be secured to the two remaining boxes using the cover retaining or device mounting screws. A threaded rod, 20 inches (508 mm) minimum long, is to be threaded into the center hole in the steel bar. The rod used for this test is to be capable of withstanding the applied force without deformation. With the box face in the vertical plane, and with the rod extending in the horizontal direction from the box face, a force four times the marked value in 33.23 or 33.24 is to be applied to the rod, 16 inches (406.4 mm) from the face of the box in a direction perpendicular to the rod. The force is to be maintained 16 inches (406.4 mm) from the face of the box by any convenient means, such as by a V-shaped groove cut into the rod. The force is to be applied for 5 minutes.

Added 26.4A.2 effective December 20, 2001

26.4A.3 After installation as specified in 26.4.2, a force of four times the marked value in 33.23 or 33.24 is to be applied for 5 minutes consecutively to each of two boxes, intended for use in a ceiling, in a direction normal to the plane of the face of the test surface along the center line of the box, and tending to pull the box out of the opening.

Added 26.4A.3 effective December 20, 2001

26.5 Polymeric supporting means

26.5.1 The polymeric supporting means of a box intended to be installed in an existing structure shall have a relative thermal index of not less than 60°C (140°F) for properties of electrical and mechanical without impact and a relative thermal index of not less than 50°C (122°F) for mechanical with impact properties.

26.5.1 revised June 4, 2001

26.5.2 The polymeric supporting means of a box intended to be installed in an existing structure shall not exhibit any cracks or change in any dimension greater than 10 percent following conditioning of the box as described in 26.5.3.

Effective date for 26.5.2 changed from February 2, 1998 to December 15, 1998

26.5.3 Sample boxes are to be conditioned for 7 hours at a temperature of 70°C (194°F) in an air-circulating oven. After the box has been removed from the oven and cooled to room temperature, the supporting means is to be examined for cracks and changes in dimensions.

Effective date for 26.5.3 changed from February 2, 1998 to December 15, 1998

No Text on This Page

26.6 Support for Floor Boxes

26.6.1 A floor box is to be subjected to the test described in paragraphs 26.6.2 and 26.6.3. The support means, such as clamps, clips, or similar components, shall not break or result in the displacement of the box more than 1/8 inch (3.2 mm) from the plane of the surface of the floor when measured 1 minute after the test load is removed.

Added 26.6.1 effective December 20, 2001

26.6.2 Six floor boxes are to be installed one at a time in a 3/4-inch (19-mm) thick plywood sheet. The plywood is to be mounted on supports spaced 16 inches on center with the box mounted in the middle of the supports. Screws for the supporting means that are larger than No. 8 are to be tightened with a torque of 35 pound-inches (3.96 N·m). A No. 8 screw is to be tightened with a torque of 20 pound-inches (2.26 N·m). A No. 6 screw is to be tightened with a torque of 12 pound-inches (1.36 N·m). See 26.4.4.

Added 26.6.2 effective December 20, 2001

26.6.3 After installation as specified in 26.6.2, a force of 50 pounds (222 N) is to be applied for 5 minutes consecutively to each of the three boxes in a direction normal to the plane of the face of the plywood sheet along the center line of the box, and tending to push the box into the opening. The same force is to be applied to each of the remaining three boxes in a direction tending to pull the box out of the opening.

Added 26.6.3 effective December 20, 2001

27 Tests on Studs

27.1 A fixture stud may be investigated as a part of a box assembly, with a bar hanger, or as a separately supplied fitting with integral mounting means.

27.2 In determining whether a stud complies with the requirements in 27.2 – 27.8, a new sample is to be used for each test.

27.3 A separate stud or one provided with a bar hanger is to be assembled to a standard octagonal outlet box for each test described in 27.4 – 27.8.

27.4 A stud and its attachment to a box, cover, bar hanger, or other device shall withstand for 5 minutes a direct pull of 200 pounds (890 N) without pulling apart or breaking.

27.5 A stud and its attachment to a box, cover, bar hanger, or device shall withstand for 1 minute, without visible damage, the application of a load as specified in Table 27.1. The load is to be applied at the end of a 20 inch (50.8 cm) rigid fixture stem attached to the stud, with the stud assembly mounted in the intended manner on the under side of a platform that is at an angle of 30 degrees with the horizontal, and that can be rotated about the axis of the fixture stud. The platform is to be rotated for six complete revolutions during the test.

Table 27.1
Load

Trade size of stud, inch	Load	
	pounds	(kg)
1/8	20	(9.07)
1/4 and Larger	30	(13.61)

27.6 The load applied at the end of the stem is to be reduced an appropriate amount to allow for the bending moment due to the weight of the stem.

27.7 A stud and its attachment to a box, cover, bar hanger, or other device shall withstand for 1 minute, without visible damage or relative movement, the application of a torque having the value specified in Table 27.2.

Table 27.2
Torque

Trade size of stud, inch	Torque,	
	pound-inches	(N·m)
1/8	200	(22.6)
1/4 and Larger	400	(45.2)

27.8 In the test required by 27.7, the stud is to be rigidly supported in the intended manner, and the torque is to be applied at the end of a lever arm attached to the stud or to an extension member that is in turn attached to the stud. The torque is to be applied in the direction tending to tighten the screw connections. The lever arm is to be measured from the axis of the stud to the point of application of the torque; and the lever arm is to be perpendicular to the axis of the stud.

28 Test on Mounting Plates

28.1 A wiring-device-mounting plate or equivalent that is secured to a metal flush-device box by a force fit or by fold-over tabs shall be subjected to the test described in 28.2. The plate shall not move or separate from the box.

28.2 The flush-device box is to be independently supported in a reliable manner. The wiring-device-mounting plate or equivalent is to be fitted with machine screws of the appropriate size in accordance with Table 28.1. If more than one screw can be used in a plate, a single screw is to be fitted into each hole nearest the center of the plate. A force that is equally divided between these screws, in a direction normal to and away from the assembly, is to be gradually increased to 100 pounds (445 N) and maintained at the value for 5 minutes.

Table 28.1
Mounting plate screw size

Screw size, number	Screw diameter,	
	inch	(mm) ^a
6	0.135	(3.43)
8	0.162	(4.12)

^a Tolerances of ±0.001 inch (0.03 mm) apply.

29 Wet and Damp Locations Test

29.1 General

29.1.1 An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate, intended for use in damp or wet locations shall comply with the applicable requirements in 29.1.1 – 29.5.3 when installed as intended.

Exception No. 1: An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate intended for use in a wet location with a cover closed need not comply with the requirements in 29.2.6 and 29.2.7.

Exception No. 2: An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate intended for use in a damp location need not comply with the requirements in 29.2.5 – 29.2.7.

29.1.2 A cover or a flush-device cover plate intended for use with a wiring device and employing a hood, a rain shield, or a similar device that requires positioning or movement in normal use shall remain functional and comply with the requirements in 29.2.1 – 29.2.7 after 1000 cycles of operation.

Exception No. 1: A cover or a flush-device cover plate marked "Wet Location With Cover Closed" need not be tested as described in 29.2.6 and 29.2.7.

Exception No. 2: A cover or a flush-device cover plate marked "Damp Locations" need not be tested as described in 29.2.5 – 29.2.7.

29.2 Resistance to moisture

29.2.1 When tested as described in 29.2.3 – 29.2.7, an assembly of parts as mentioned in 29.1 – hereinafter referred to as the test assembly – shall exclude water from:

- a) The enclosure formed by a box and a cover or a flush-device cover plate, and
- b) The interior of a wiring device.

29.2.1 revised November 30, 2001

29.2.2 With reference to 29.2.1(b), to determine whether water has entered the interior of a wiring device, it may be necessary to provide one or more passages in that portion of the wiring device enclosed by the box and cover or flush-device cover plate so that any water entering the wiring device can be drained from the wiring device. During the required tests, these passages are to be blocked with putty or the like; and after the tests, the putty is to be removed and any water that may have entered is to be drained from the wiring device.

29.2.3 The test assembly is to be installed as intended in actual service in accordance with the assembly and installation instructions. If the instructions do not include sufficient details, a cover or a flush-device cover plate is to be installed in the manner most likely to permit the entry of water. The interior of the test assembly is to be vented to the exterior to equalize the atmospheric pressure during the test. The vent is to be protected so that water cannot enter. All parts intended for use with the part under test, or that are necessary to complete the enclosure are to be employed for the test – for example, wiring devices, gaskets, covers for boxes, or boxes for covers. A cover or a flush-device cover plate intended for use with a box mounted in a wall is to be tested employing a wall of the most severe irregular surface not clearly prohibited by the assembly or installation instructions – such as a wall of fieldstone, corrugated siding, flagstone, textured face brick, common brick, grooved siding, flat or drop striated siding, flat or drop embossed siding, flat or drop textured siding, flat or drop smooth siding, or the like. A box that is intended to be mounted in a wall used for the test assembly is to have all openings sealed by wax, putty, or the like to trap any water entering the assembly.

29.2.4 The test assembly is to be located approximately 5 feet (1.52 m) under the test apparatus as described in 29.3.1. A flat surface 1 foot (0.3 m) wide by 2 feet (0.6 m) long is to be positioned so that:

- a) The surface is horizontal and 1 foot below the center line of the test assembly; and
- b) The long side of the surface is parallel to the test assembly or to the wall in which the test assembly is mounted.

The test assembly is to be closed during the test – for example, if the wiring device employed is a receptacle, the test is to be conducted without an attachment plug in the receptacle. The spray is to be applied for 1 hour, with the water pressure maintained at 5 psi (34.47 kPa). Following the spray, the test assembly is to be examined to determine whether it complies with the requirements in 29.2.1.

29.2.5 The test assembly is to be located 3 feet (0.9 m) horizontally from and 2 feet (0.6 m) above a spray head as illustrated in Figure 29.1. The spray head is to be positioned so that the spray is aimed directly at the test assembly. The water pressure is to be maintained at 15 psi (103.4 kPa). The cover, the guard, the shield, or the like is to be opened completely, and then allowed to assume its natural position; that is, a self-closing cover is to be allowed to close. However, a cover with a detent or other feature designed to hold it open is not to be assisted in closing. If the wiring device employed is a receptacle, the test is to be conducted without an attachment plug in the receptacle. The spray is to be applied for 1 hour. Following the spray, the test assembly is to be examined to determine whether it complies with the requirements in 29.2.1.

29.2.6 If the wiring device employed in the test assembly is a receptacle, the test described in 29.2.4 is to be repeated but with an attachment plug in the receptacle. The attachment plug is to be inserted into the receptacle by first fully opening the cover, guard, shield, or the like of the test assembly and then completely inserting one of the attachment plugs specified in Table 29.1 into the receptacle. The cover, the guard, the shield, or the like is then to be allowed to assume its natural position – that is, a self-closing cover is to be allowed to close on the attachment plug, and a cover with a detent or other feature intended to hold it open is not to be assisted to close on the attachment plug. The insertion of the attachment plug and positioning of a shield or other device other than a cover that is employed to protect the wiring device is to be accomplished with the degree of misuse likely to be encountered in actual service. If a duplex receptacle is employed, the test is to be conducted using only one attachment plug. The test is then to be repeated using the other attachment plug specified in Table 29.1.

Exception No. 1: Only one test need be conducted provided that the test with one attachment plug represents the conditions most likely to permit entry of water into the assembly.

Exception No. 2: A receptacle intended for use with an attachment plug other than the two wire nongrounding parallel- or tandem-blade type specified in Table 29.1 shall be tested with an attachment plug of the type intended for use with the receptacle.

29.2.6 revised December 20, 1999

Table 29.1
Two-wire attachment plugs

Plug dimensions, inch (mm) ^a		Type of cord	Size of conductors,		Length of cord,	
Face dimensions	Length		AWG	(mm ²)	feet	(m)
3/8 (9.5) by 1 (25.4)	1 (25.4)	SPT-1	18	(0.82)	3	(0.9)
7/8 (22.2) diameter	2 (50.8)	SJ	14	(2.1)	3	(0.9)

^a Test plugs may be formed to the dimensions specified by casting plugs of smaller dimensions in hobby craft casting materials using a mold of the proper dimensions.

29.2.7 If the wiring device employed in the test assembly is a receptacle, the test described in 29.2.5 is to be repeated but with an attachment plug in the receptacle as described in 29.2.6.

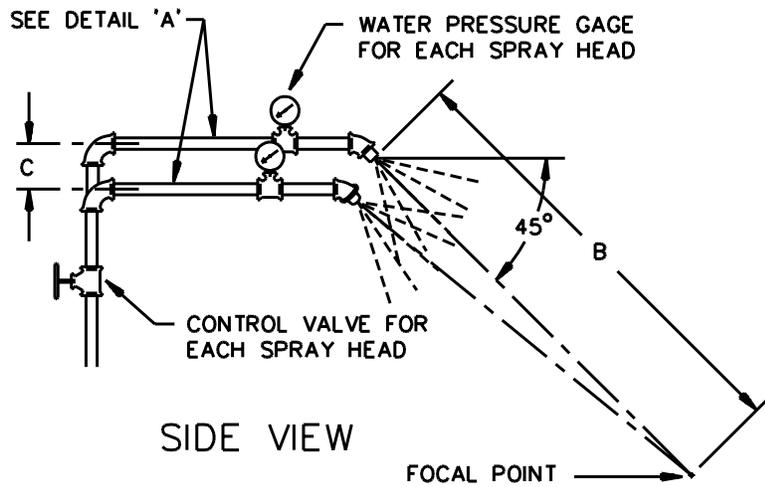
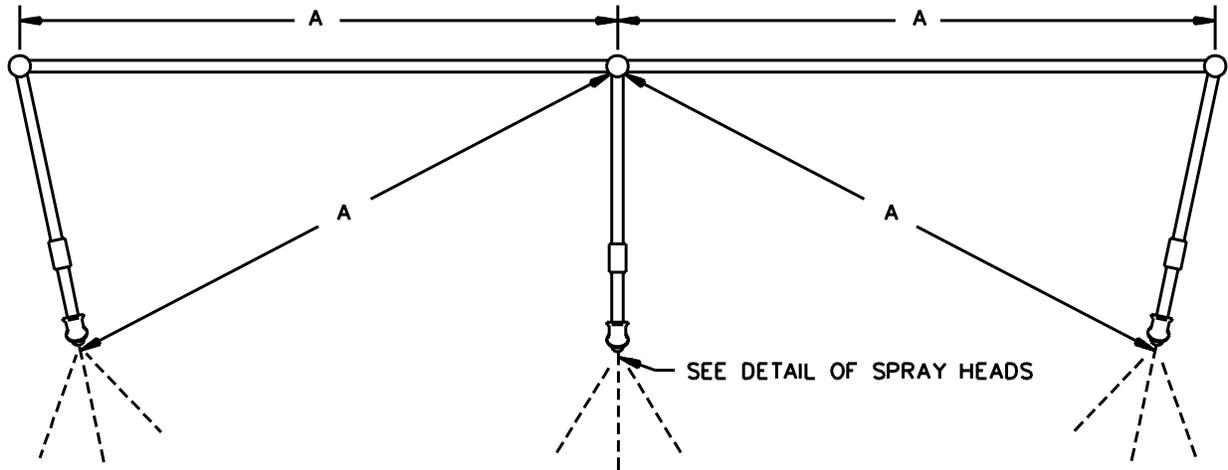
29.3 Water-spray apparatus

29.3.1 The water-spray apparatus is to consist of three spray heads constructed in accordance with the details illustrated in Figure 29.1 and mounted in a water supply pipe rack as illustrated in Figure 29.2. The assembly is to be brought into the focal area of the three spray heads in such a position and under such conditions that water will be most likely to enter, except that consideration is to be given to the normal mounting position.

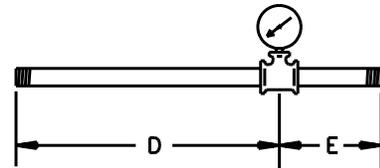
Figure 29.2
Spray head pipe rack

Figure 29.2 revised July 23, 1998

PLAN VIEW



PIEZOMETER ASSEMBLY
DETAIL 'A'



SIDE VIEW

RT101B

Item	inch	mm
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

29.4 Resistance to ultraviolet light and water

29.4.1 Any part of a cover or a flush-device cover plate that is nonmetallic and may be exposed to sunlight shall be exposed to ultraviolet light and water for 720 hours under the conditions specified in 29.4.2 – 29.4.4. The part shall not show any apparent deterioration.

Exception: This requirement does not apply to the edges of a gasket.

29.4.2 Three samples of the part are to be fastened to the specimen drum of an apparatus as described in 29.4.3 and 29.4.4. After 720 hours of exposure the samples are to be removed from the drum and visually compared to an unconditioned sample.

29.4.3 The samples are to be exposed to ultraviolet light from two carbon arcs formed between vertical electrodes 1/2 inch (12.7 mm) in diameter located at the center of a revolvable vertical metal cylinder 31 inches (787 mm) in diameter and 17-3/4 inches (451 mm) high. Each arc is to be enclosed by a clear glass globe.

29.4.4 The samples are to be mounted vertically on the inside of the cylinder facing the arcs, and the cylinder is to be rotated around the arcs at one revolution per minute. A system of nozzles is to be employed to spray each sample with water as the cylinder revolves. The operating cycle is to be 102 minutes of light only and 18 minutes of light and water. The temperature within the cylinder while the apparatus is in operation is to be $63.0 \pm 5.0^\circ\text{C}$ ($145 \pm 9.0^\circ\text{F}$), and the test is to be continued until 720 hours have elapsed.

29.5 Sealing compound

29.5.1 A compound provided to prevent the entrance of water between a cover or a flush-device cover plate and the mounting surface shall be subjected to the conditioning described in 29.5.2 and 29.5.3. The compound shall remain effective and show no apparent deterioration.

29.5.2 Three test assemblies consisting of a cover or a flush-device cover plate, a box with which it is intended to be used, and the compound are to be tested. The test assemblies are to be assembled in the intended manner. Each assembly is to be conditioned for 168 hours at a temperature of $90.0 \pm 1.0^\circ\text{C}$ ($194.0 \pm 1.8^\circ\text{F}$) in an air-circulating oven. Following the conditioning, each assembly is to be examined to determine whether it complies with the requirements in 29.5.1.

29.5.3 Three covers or flush-device cover plates are to be mounted on plywood with a 1/32-inch (0.8-mm) diameter wooden rod, that may project 1/2 inch (12.7 mm) beyond the edge of the cover or the flush-device cover plate, between the cover or the flush-device cover plate and the plywood at the center of each side. The compound is to be applied around the cover or the flush-device cover plate. The assemblies are to be conditioned for 24 hours at minus 20°C (minus 4°F) in circulating air. Following the conditioning, each assembly is to be investigated to determine whether it complies with the requirements in 29.5.1.

29.6 Gaskets

29.6.1 When tested in accordance with 29.6.2, a rubber or rubber-like component employed to prevent the entrance of water shall show no apparent deterioration and shall not show a change in hardness of more than 10 units.

29.6.2 The hardness of the unaged material is to be determined as the average of five readings with a gauge – such as the Rex hardness gauge or the Shore durometer – and the component is then to be placed in an air oven for 70 hours at $100 \pm 2^\circ\text{C}$ ($212 \pm 3.6^\circ\text{F}$). The component is to be allowed to rest at room temperature for not less than 4 hours after removal from the oven, and the hardness is then to be determined again as the average of five readings. The difference between the original hardness reading and the reading taken after the air oven aging is the change in hardness.

29.6.3 An expanded (foam) closed-cell rubber gasket shall be conditioned as described in 29.6.4. After conditioning, the thickness of the gasket shall not be less than 50 percent of the original deflection.

29.6.4 Three specimens, each 1.14 ± 0.02 inch (29.0 ± 0.5 mm) in diameter and 0.50 ± 0.02 inch (12.7 ± 0.5 mm) thick are to be prepared, using as many thicknesses of the material as necessary. Each specimen is to be conditioned for 24 hours at a temperature of $23 \pm 2^\circ\text{C}$ ($73 \pm 4^\circ\text{F}$) while compressed by one-third its original thickness between flat steel plates. At the end of this period, the specimens are to be removed from between the compression plates. After an additional 24 hours, the thickness is to be measured at the center of each specimen.

30 Concrete-Tightness Test

30.1 A concrete-tight box shall be subjected to the test described in 30.2 – 30.6 and there shall be no entrance of concrete aggregate into the box.

Exception No. 1: A box that is constructed so that it will obviously exclude concrete aggregate need not be tested.

Exception No. 2: A box that excludes water when tested as described in Section 29 is considered to be concrete-tight and need not be tested.

30.1 effective February 2, 1998

30.2 The box is to be assembled in accordance with the installation instructions. If no instructions are provided, a box with adjusting means is to be tested in an adjusted position such that concrete will be most likely to enter, except that consideration is to be given to the normal mounting position. The box is to be secured to the bottom of the formwork used to contain the concrete. The formwork is to be filled with concrete prepared in accordance with 30.3. The concrete is to be vibrated immediately after it is poured using a vibrator that is in accordance with 30.4. A box intended to be used in a wall or ceiling is to be tested in accordance with 30.5. A box intended to be used in a floor is to be tested in accordance with 30.6. Twenty-four hours after the concrete has been poured, the box is to be broken loose from the concrete and the interior of the box is to be examined.

30.2 effective February 2, 1998

30.3 Portland-type cement is to be used in the preparation of the concrete for the test required by 30.1. The sand is to be of the type known to the construction industry as mason sand. The cement-sand ratio is to be 1:2 by volume, and there is to be a 1/16-inch (1.6-mm) deep film of water on the surface of the mixture after it has stood for 1 minute in the mixing vat.

30.4 The concrete is to be vibrated with an internal type vibrator that operates between 13,500 and 15,000 vibrations per minute in free air. The vibrator head is to have a:

- a) Circumference not less than 3.75 inches (95 mm) and not greater than 5.5 inches (140 mm); and
- b) Length not less than 14 inches (356 mm) and not greater than 16 inches (406 mm).

30.4 effective February 2, 1998

30.5 A box intended to be used in a concrete wall or ceiling is to be covered with a minimum of 2 feet (0.61 m) of concrete. The vibrator head is to be placed into the concrete so that:

- a) Its major axis is vertical; and
- b) Its free end is within 1 inch (25.4 mm) of the bottom of the formwork and within 1 inch of the assembly.

The head is then to be withdrawn at a rate not less than 1 inch per second and not more than 2 inches (50.8 mm) per second. This procedure is to be repeated until all the concrete has been vibrated as indicated by an overlap of vibration patterns over the entire surface. The vibrator head is not to come in contact with the assembly or the formwork. The total vibration time is to be 10 seconds per cubic foot of concrete used.

30.5 effective February 2, 1998

30.6 A box intended to be used in a concrete floor is to be covered with a minimum of 1/2 inch (12.7 mm) of concrete. The vibrator head is to be placed into the concrete and then pulled completely around the assembly in a continuous circular motion. During this procedure all the concrete is to be vibrated as indicated by an overlap of vibration patterns over the entire surface. The vibrator head is not to come in contact with the assembly or the formwork. The total vibration time is to be 10 seconds per cubic foot of concrete used.

30.6 effective February 2, 1998

31 Scrub-Water-Tightness Test

31.1 Revised and relocated as 32A.2.1 effective December 20, 2001

31.2 Revised and relocated as 32A.2.2 effective December 20, 2001

31.3 Revised and relocated as 32A.2.3 effective December 20, 2001

32 Resistance Test

32.1 Revised and relocated as 32A.4.1 December 20, 1999

32.2 Relocated as 32A.4.2 December 20, 1999

32A Tests on Floor Boxes

32A.1 General

32A.1.1 A floor box shall be subjected to the tests described in 32A.2 – 32A.4.

Exception No. 1: The tests in 32A.2 and 32A.4 do not apply to a raised-floor box.

Exception No. 2: The tests in 32A.2.4 do not apply to a floor box intended for use in tile covered floors.

Added 32A.1.1 effective December 20, 2001

32A.1.2 A floor box intended for use in carpet or wood covered floors and marked in accordance with 33.25 shall be subjected to the tests described in 32A.2.1, 32A.2.2, and 32A.2.4.

Effective date for 32A.1.2 changed from December 20, 2001 to June 20, 2003

32A.1.3 A cast metal floor box intended for use with a wiring device connected as described in 16.8 shall also be subjected to the Resistance Test, Section 32A.4.

Added 32A.1.3 effective December 20, 2001

32A.2 Scrub-water exclusion test

32A.2.1 A floor box shall be subjected to the test described in 32A.2.2 – 32A.2.4. Scrub-water shall not enter a floor box at the floor level through the box cover, cover flange, or other openings.

Effective date for 32A.2.1 changed from December 20, 2001 to June 20, 2003

32A.2.2 A floor box assembly is to be installed in a section of a floor constructed to represent an installation as intended by the manufacturer. The cover plate is to be fully secured. Sealing compound is to be used around the perimeter of the floor box or cover flange, to retain the soap solution on the floor assembly. A minimum 1/4-inch (6.3-mm) high dam is to be constructed around the floor assembly.

Effective date for 32A.2.2 changed from December 20, 2001 to June 20, 2003

32A.2.3 A scrub-water solution is to be prepared by mixing 4 tablespoons of floor cleaning soap with 1.0 gallon (3.79 L) of water. The solution is to be poured over the cover plate of the floor box so that it collects to a depth of 1/8 inch (3.2 mm) above the floor assembly within 10 seconds or less. The solution is to remain on the floor assembly for 1 minute. The solution is then to be removed and the interior and under the cover of the floor box is to be examined for entrance of scrub-water.

Effective date for 32A.2.3 changed from December 20, 2001 to June 20, 2003

32A.2.4 A scrub-water solution is to be prepared by mixing one tablespoon of floor cleaning soap with 1.0 quart (0.94 L) of water. The solution is to be poured over the cover plate of the floor box within 10 seconds or less. The solution is to run off the top and the sides of the cover. The cover is then to be dried. The interior and under the cover of the floor box is to be examined for entrance of scrub-water.

Effective date for 32A.2.4 changed from December 20, 2001 to June 20, 2003

32A.3 Floor box and cover loading test

32A.3.1 An access cover or receptacle cover plate intended for use with a floor box or a raised-floor box is to be subjected to the test described in 32A.3.4. The cover and floor box shall support the test load for one minute without deflecting more than 1/8 inch (3.2 mm). The deflection is to be measured when the force applied reaches the specified value. The permanent deformation at any point on the cover, exclusive of gasket compression, shall not exceed 1/32 inch (0.8 mm), measured 1 hour after the test load is removed. A raised-floor box shall withstand the loading without structural failure to the mounting hardware.

Added 32A.3.1 effective December 20, 2001

32A.3.2 For an access cover or receptacle cover plate, one sample is to be tested. The cover or cover plate is to be assembled to a floor box in accordance with the manufacturer's installation instructions. Appropriate wiring devices are to be installed.

Added 32A.3.2 effective December 20, 2001

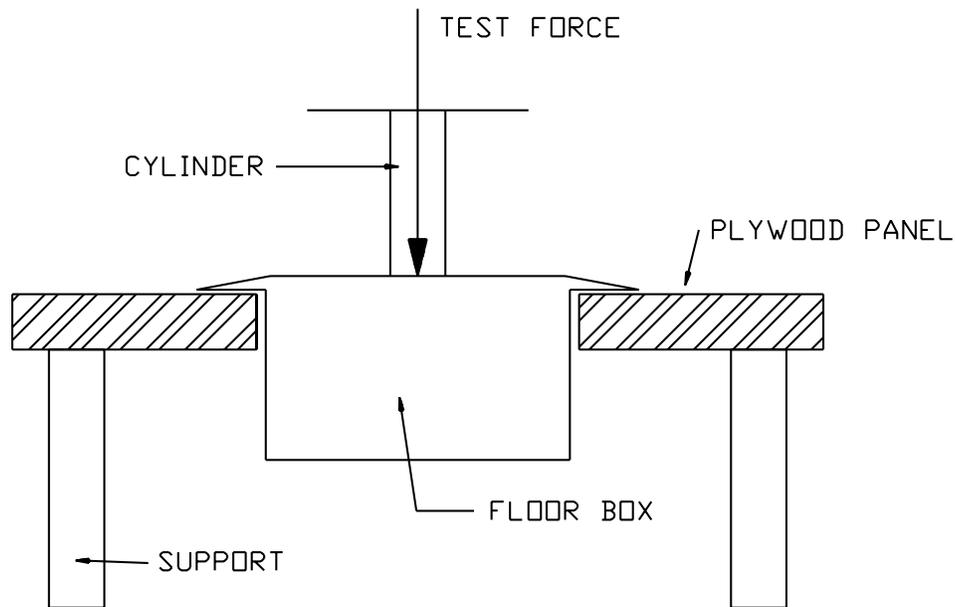
32A.3.3 For a floor box, one sample of the box is to be installed in accordance with the manufacturer's installation instructions in the center of a 3/4-inch (19-mm) thick plywood sheet that is 24 inches (610 mm) longer and 24 inches (610 mm) wider than the panel opening specified by the manufacturer. The assembly is to be supported on each side so that the box hangs freely beneath the panel, as shown in Figure 32A.1. The supports are to be placed 6 inches (152 mm) from the outermost edge of the mounting flange of the box.

Added 32A.3.3 effective December 20, 2001

No Text on This Page

Figure 32A.1
Floor box assembly

Added Figure 32A.1 effective December 20, 2001



SM374B

32A.3.4 The assembly described in 32A.3.2 and 32A.3.3 is to be subjected to the application of a load by means of a weight that exerts a force of 300 pounds (1334 N) through the flat end of a solid, right circular cylinder, 3 inches (76 mm) in diameter and a minimum of 1 inch (25 mm) long, as shown in Figure 32A.1. The force is to be applied to the cover at the point resulting in maximum deflection.

Added 32A.3.4 effective December 20, 2001

32A.4 Resistance test

32A.4.1 A cast-metal floor box and a device connected as described in 16.8 is to be subjected to the test described in 32A.4.2. The voltage drop between the box and the device shall not be more than 10 millivolts.

32.1 revised and relocated as 32A.4.1 December 20, 1999

32A.4.2 The resistance is to be determined by causing a current of 30 amperes to flow through the assembly of the box and the device mounting yoke. The voltage is to be measured between a point on the box 1/16 inch (1.6 mm) from the nearest wireway connection and any point on the device mounting yoke.

32.2 revised and relocated as 32A.4.2 December 20, 1999

MARKING

33 General

33.1 All markings shall be legible. All product markings shall be permanent and visible after the product is installed. The following types of markings or the equivalent are considered permanent:

- a) Etched;
- b) Molded;
- c) Die stamped;
- d) Paint stenciled; or
- e) Indelibly stamped,

on a pressure sensitive label secured by adhesive and complying with the Standard for Marking and Labeling Systems, UL 969.

33.1 effective February 2, 1998

33.2 A box and a separately shipped cover shall be plainly marked with the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified and, if practicable, with a catalog number or an equivalent designation. The catalog number or an equivalent designation, if not marked on the product, shall appear on the carton or other container in which the product is packaged. The marking on a sheet-metal box shall be located on the inside surface of the box.

33.3 A required marking shall not be on a removable part of a box unless it is duplicated on at least one other part.

33.4 If a manufacturer produces or assembles boxes or covers at more than one factory, each finished product shall have a distinctive marking to identify it as a product of a particular factory.

33.5 A clamp or connector furnished as part of an outlet box shall be marked to indicate the type of application for which it is intended to be used – A for armored cable, F for flexible metal conduit, N for nonmetallic-sheathed cable, and T for flexible tubing, MCI for metal clad interlocking armored cable (steel and aluminum type), MCS for metal clad continuous smooth sheath cable, MCC for metal clad continuous corrugated sheath cable, and ALL if it is acceptable for use in all types of applications.

33.6 A clamp for armored or metal clad cable that is not acceptable for No. 14 AWG (2.1 mm²), 2-wire cable, shall be marked for cable of the smallest size for which it is acceptable.

33.7 A clamp intended to secure more than one nonmetallic-sheathed cable per opening shall be marked with the number of cables it is intended to secure. The marking shall be located on:

- a) The clamp; or
- b) The smallest unit shipping carton in which the box is packed.

33.7 effective February 2, 1998

33.8 A clamp intended to secure nonmetallic-sheathed cable of a size or sizes other than specified in 13.1.1.7 shall be marked to indicate the specific size or sizes it is intended to secure. A range of sizes, a maximum or minimum size, or the equivalent may be used to represent a group of sizes. The marking shall be located on:

- a) The clamp; or
- b) The smallest unit shipping carton in which the box is packed.

33.9 A metal box as described in Exception No. 1 to 16.2 that is provided with a tapped hole for a grounding screw other than a No. 10-32 screw shall be marked "GR" or "GRD," or the equivalent, adjacent to the hole.

33.9 revised December 20, 1999

33.10 If a box is provided with a sheet-metal plug or plate in accordance with 12.3, the box or the carton in which it is shipped shall be marked to indicate that the box is intended for installation only in concrete.

33.11 A box having a volume of 100 cubic inches (1639 cm³) or less and a conduit body having provision for more than two tubing or conduit entries or having provision for mounting wiring devices, an extension ring, or a raised cover shall be durably and legibly marked with a volume in cubic inches that does not exceed its actual volume. The marking shall be readily visible after installation. See 33.12.

Exception: A box or extension ring of one of the trade sizes specified in Table 33.1 and having the minimum volume specified in that table need not be marked.

Table 33.1
Volume of outlet boxes

Box dimensions – inches, ^a trade size, or type	Minimum capacity ^a cubic inches (cubic centimeters)	
4 × 1-1/4 round or octagonal	12.5	(205)
4 × 1-1/2 round or octagonal	15.5	(254)
4 × 2-1/8 round or octagonal	21.5	(352)
4 × 1-1/4 square	18.0	(295)
4 × 1-1/2 square	21.0	(344)
4 × 2-1/8 square	30.3	(497)
4-11/16 × 1-1/4 square	25.5	(418)
4-11/16 × 1-1/2 square	29.5	(483)
4-11/16 × 2-1/8 square	42.0	(688)
3 × 2 × 1-1/2 device	7.5	(123)
3 × 2 × 2 device	10.0	(164)
3 × 2 × 2-1/4 device	10.5	(172)
3 × 2 × 2-1/2 device	12.5	(205)
3 × 2 × 2-3/4 device	14.0	(229)
3 × 2 × 3-1/2 device	18.0	(295)
4 × 2-1/8 × 1-1/2 device	10.3	(169)
4 × 2-1/8 × 1-7/8 device	13.0	(213)
4 × 2-1/8 × 2-1/8 device	14.5	(238)
3-3/4 × 2 × 2-1/2 masonry box	14.0 ^b	(229)
3-3/4 × 2 × 3-1/2 masonry box	21.0 ^b	(344)
FS – minimum internal depth 1-3/4	13.5 ^{b,c}	(221)
FD – minimum internal depth 2-3/8	18.0 ^{b,c}	(295)

Table 33.1 Continued on Next Page

Table 33.1 Continued

Box dimensions – inches, ^a trade size, or type		Minimum capacity ^a cubic inches (cubic centimeters)	
FS – minimum internal depth 1-3/4		18.0 ^{b,d}	(295)
FD – minimum internal depth 2-3/8		24.0 ^{b,d}	(393)
^a Metric equivalents of the dimensions in this table are:			
Inches	Millimeters	Cubic inches	Cubic centimeters
1-1/4	31.8	7.5	123
1-1/2	38.1	10.0	164
1-3/4	44.5	10.3	169
1-7/8	47.6	10.5	172
2	50.8	12.5	205
2-1/8	54.0	13.0	213
2-1/4	57.2	13.5	221
2-3/8	60.3	14.0	229
2-1/2	63.5	14.5	238
2-3/4	69.9	15.5	254
3	76.2	18.0	295
3-1/2	88.9	21.0	344
3-3/4	95.3	21.5	352
4	102	24.0	393
4-11/16	119	25.5	418
		30.3	497
		42.0	688
^b Minimum capacity per gang.			
^c Single gang.			
^d Multiple gang.			

33.12 The marked volume of a box or other device is to be reduced from that determined in accordance with Volume Verification Test, Section 23, to the nearest 1/4 cubic inch (4.1 cm³). Volumes of 1/4 cubic inch and 3/4 cubic inch (12.3 cm³) are able to be indicated as 0.3 cubic inch (5 cm³) and 0.8 cubic inch (13 cm³), respectively.

33.12 revised December 20, 1999

33.13 A conduit body that has been investigated for a specific combination of conductors shall be permanently marked with the maximum number and maximum size of the conductors for which it is intended. See the exceptions to 9.2.3 and 9.2.4.

No Text on This Page

33.14 For a box or assembly that has been found acceptable for specific conditions of installation or use with certain wiring systems, such condition of installation or intended use shall be indicated by a marking on the smallest unit carton in which the product is packed. Table 33.2 specifies the condition of use and the associated uniform carton marking.

Table 33.2
Marking specifications

Condition of use or installation	Carton marking ^a
For use in poured concrete	Concretetight
For floor use	Floor box
For the support of electric fixtures	For fixture support
For use with specific type of rigid nonmetallic conduit above or below ground	For ^b rigid nonmetallic conduit
For use with specific types of cables or conduits	For ^c
<p>^a The carton marking specified above may be prefixed by "Suitable For" or may use the word "only" as desired or appropriate.</p> <p>^b Represents the use of appropriate type of conduit such as PVC, above-ground, or the like, as required or appropriate.</p> <p>^c Represents the use of the appropriate type of cable or conduit, such as flexible tubing, armored cable, flexible conduit, or nonmetallic sheathed cable.</p>	

33.15 Additional marking in the complete form specified in Table 33.2 or in an equivalent abbreviated form may be provided on the product.

33.16 An outlet box intended to support a ceiling-suspended fan weighing 35 pounds (15.9 kg) or less shall be marked "Acceptable for Fan Support." See also 18.1.

Revised 33.16 effective December 20, 2001

33.16A An outlet box intended to support a ceiling-suspended fan weighing more than 35 pounds (15.9 kg) and 50 pounds (22.7 kg) or less shall be marked "Acceptable for Fan Support of 50 lbs (22.7 kg) or less." See also 18.1.

Added 33.16A effective December 20, 2001

33.16B An outlet box intended to support a ceiling-suspended fan weighing more than 50 pounds (22.7 kg) and 70 pounds (31.7 kg) or less shall be marked "Acceptable for Fan Support of 70 lbs (31.7 kg) or less." See also 18.1.

Added 33.16B effective December 20, 2001

33.17 An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate acceptable for use in a wet location shall be marked "Wet Locations," and may also be marked "Damp Locations."

33.18 An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate acceptable for use in a wet location with the cover closed shall be marked "Wet Location Only When Cover Closed," and may also be marked "Damp Locations."

33.19 An outlet box, a conduit body, an outlet box cover, and a flush-device cover plate acceptable for use in a damp location shall be marked "Damp Locations."

33.20 The markings indicating damp location, wet location with cover closed, or wet location, shall be visible after installation.

33.21 A conduit body or the smallest unit shipping carton in which it is packed may be marked with a type number, for example, "Type _____," indicating the external conditions for which it is acceptable. See the Standard for Enclosures for Electrical Equipment, UL 50. A conduit body that complies with the requirements for more than one type may have multiple designations.

33.22 An outlet box intended to support a ceiling-suspended fan, and provided with screws or a screw and nut assembly, other than No. 8-32 or No. 10-32, shall be marked with the size and number of threads per inch of the screws or nuts. The marking shall be on the inside surface of the box. See 18.1.

33.22 revised December 20, 1999

33.23 With reference to 14.1.9, a box shall be marked for the intended end-use application (wall, ceiling, or both) and marked "For Support of _____lb Fixture or Product (or specific product identification)." The blank shall be filled with a number, in 1-pound increments, from 7 to 15.

Added 33.23 effective December 20, 2001

33.24 With reference to 14.1.10, a box shall be marked for the intended end-use application (wall, ceiling, or both) and marked "For Support of _____lb Fixture or Product (or specific product identification)." The blank shall be filled with a number, in 1-pound increments, from 16 to 49.

Added 33.24 effective December 20, 2001

33.25 With reference to 32A.1.2, a cover for a floor box intended for use only in a floor covered with carpet or wood shall be marked on the product or smallest unit shipping carton "Not for use with tile covered floors," or the equivalent.

Effective date for 33.25 changed from December 20, 2001 to June 20, 2003

33.26 An outlet box, with or without a bracket or bar hanger, intended to support a fixture weighing more than 50 lbs (22.7 kg) shall be marked "For Fixture Support of ___ lbs (___ kg) or less." The blank is to be filled in with the weight intended to be supported in 20-pound increments, for example 70, 90, 110 lbs (31.7, 40.8, 49.9 kg). Marking the carton in addition to marking the box complies with the requirement.

Added 33.26 effective December 20, 2001

34 Instructions

34.1 Instructions describing the method of assembly shall be provided with the box supporting means that is assembled for tests as described in 26.4.2.

34.1 revised December 20, 1999

34.2 An outlet box intended to support a ceiling-suspended fan (see 18.1) shall be provided with:

- a) Installation instructions for mounting of the box; and
- b) Installation instructions for securement of the fan mounting bracket to the box specifying that only the screws provided with the outlet box shall be used.

34.3 A box intended to support a product in accordance with 14.1.8 shall be provided with:

- a) Installation instructions for mounting of the box; and
- b) Installation instructions that specify the type and thickness of the finished surface the box is to be mounted in.

Added 34.3 effective December 20, 2001

SUPPLEMENT SA - METALLIC OUTLET BOXES FOR MARINE USE

GENERAL

SA1 Scope

SA1.1 The requirements in this supplement cover metallic outlet boxes, flush device boxes, special purpose boxes, extension rings, covers, and flush device cover plates for use in marine applications.

SA1.2 The products covered by the requirements in this supplement are intended for installation in accordance with the manufacturer's instructions and the applicable requirements of the United States Coast Guard (USCG); IEEE Recommended Practice for Electric Installation on Shipboard, IEEE Standard 45; the American Boat and Yacht Council (ABYC); and the National Fire Protection Association Standard for Pleasure and Commercial Motor Craft, NFPA 302.

SA1.3 A product intended for marine use shall comply with the requirements in Sections 4– 34, as applicable; except as modified or superseded by the requirements in this supplement.

SA2 Glossary

SA2.1 For the purposes of this supplement the following definitions apply.

SA2.2 DRIPPROOF – A product that is constructed or so protected that falling drops of liquid or solid particle striking the enclosure, from 0 to 15 degrees downward from the vertical, do not interfere with the intended operation of the equipment.

SA2.3 WATERTIGHT – A product that is constructed so that moisture will not enter the enclosure under specified test conditions in Watertightness Test, Section SA6.

CONSTRUCTION

SA3 General

SA3.1 A metallic box not designated as watertight is to be tested as a dripproof enclosure. See SA2.2.

SA4 Mounting

SA4.1 A metallic box and an extension ring, unless otherwise marked on the smallest unit box or shipping carton, shall not support a ceiling fixture.

SA4.2 A metallic box designated as watertight shall be provided with external mounting provisions. There shall be no holes or knockouts in the side walls or bottom of the box; except those for supply connections.

SA5 Supply Connections

SA5.1 A metallic box designated as watertight may have stuffing tubes or other cable entry fittings acceptable for the application. The carton used to ship these devices or the shipping label attached to a carton shall be marked in accordance with SA10.1.

PERFORMANCE

SA6 Watertightness Test

SA6.1 For a metallic box marked "Watertight" there shall be no evidence of water leakage when tested as specified in SA6.2 and SA6.3.

SA6.2 The assembly is to be mounted as intended in service, including the method of wiring if provided. A solid stream of water from a 1 inch (25.4 mm) diameter nozzle and at a flow rate of 65 gallons (256 L) per minute, measured at the nozzle, is to be directed at the enclosure from a distance of 10 feet (3.1 m) for 5 minutes.

SA6.3 Any water on the exterior of the enclosure is to be removed with a cloth and the enclosure then opened and examined for any evidence of water.

SA7 Dripproof Test

SA7.1 A metallic box marked "Dripproof" is acceptable if at the conclusion of the test specified in SA7.2, no accumulation of water is retained by the box.

Exception: A box marked "Watertight" complies with this requirement and need not be tested.

SA7.2 The metallic box is to be mounted beneath a drip pan that produces both splashing and dripping and extends beyond all exposed sides of the enclosure. The bottom of the drip pan is to be equipped with uniformly distributed spouts; one spout for each 20 square inches (129 cm²) of pan area. Each spout is to drip water at a rate of approximately 20 drops per minute. The metallic box is to be oriented from 0 – 15 degrees from the vertical and is to be subjected to continuously dripping water for 30 minutes.

SA8 Air-Oven Conditioning Test – Gaskets

SA8.1 An elastomeric part shall not crack or show visible evidence of deterioration when conditioned in an air oven maintained at 100 ±1°C (212 ±2°F) for 168 hours.

SA8.2 At the conclusion of the conditioning, the part is to be removed from the oven, manually flexed, and examined for compliance with the requirement in SA8.1.

SA9 Salt Spray Test

SA9.1 A metallic box is to be conditioned in accordance with the Standard Method of Salt Spray (Fog) Testing, ASTM B117-90. The exposure time is to be 6 weeks. Following the conditioning, there shall be no significant signs of corrosion such as pitting, cracking, blistering, and the like.

Exception: A product constructed in accordance with the requirements in Protection Against Corrosion, Section 7, need not be tested.

SA9.2 The apparatus for salt-spray (fog) testing is to consist of:

- a) A fog chamber, the inside of which measures 48 by 30 by 36 inches (1.2 by 0.8 by 0.9 m);
- b) A salt solution reservoir;
- c) A supply of conditioned compressed air;
- d) One dispersion tower constructed in accordance with ASTM B117-90 for producing a salt fog;
- e) Specimen supports;
- f) Provision for heating the chamber; and
- g) The necessary means of control.

SA9.3 The dispersion tower producing the salt fog is to be located in the center of the chamber and is to be supplied with humidified air at a pressure of 17 – 19 psi (117 – 131 kPa) so that the salt solution is aspirated as a fine mist or fog into the interior of the chamber.

MARKING

SA10 General

SA10.1 The cartons used to ship these products or the shipping label shall be marked "Acceptable For Marine Use," or the equivalent.

SA10.2 In addition to the applicable markings required in 33.17 – 33.19, a product or the smallest unit shipping carton in which it is packed shall be marked with the terms "Watertight" or "Drip-proof," as applicable, or with a type number, for example, "Type _____," indicating the external conditions for which it is acceptable. See the Standard for Enclosures for Electrical Equipment, UL 50.

No Text on This Page

**Superseded requirements for
the Standard for
Metallic Outlet Boxes**

UL 514A, Ninth Edition

The requirements shown are the current requirements that have been superseded by requirements in this edition. The numbers in parentheses refer to the new requirements with future effective dates that have superseded these requirements. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

18.1 (18.1) In addition to the requirements for metallic outlet boxes in this Standard, an outlet box intended to support a ceiling-suspended fan shall:

a) Be provided with a minimum of two steel cover retaining or fan mounting screws and matching threaded or unthreaded holes. Where screws other than No. 8-32 or No. 10-32 screws are provided, the box shall be marked in accordance with 33.22. A box having unthreaded holes shall be provided with:

- 1) Screws of the thread cutting type; or
- 2) A screw and nut assembly for use with clearance holes.

For a screw and nut assembly, the screws shall be held such that they are not able to rotate.

- b) Comply with the support tests in 26.2.1 – 26.3.5.
- c) Be marked in accordance with 33.16.
- d) Be provided with installation instructions in accordance with 34.2.

26.2.1 (26.2.1) A hanger or other device for the support of a box shall withstand a pull of 200 pounds (890 N) if either the device or a box with which it is provided is intended for the support of a fixture. The supporting device may bend but it shall not break, and the box shall not be pulled loose from the supporting device.

Exception: A bar hanger made of 3/16 by 1/2 inch (4.8 by 12.7 mm) or larger steel bar stock need not be tested if the hanger is not provided as part of a box or with means for attachment to a box.

26.2.2 (26.2.2) The requirement in 26.2.1 will necessitate testing of:

- a) A bar hanger, except as noted in the exception to 26.2.1, and
- b) A device other than a bar hanger if the device or the smallest unit carton in which the device is packed is marked to indicate the device is for fixture support.
- c) A box provided with a fixture stud or other means for the support of a fixture.

26.2.3 (26.2.3) The box-supporting device is to be mounted rigidly so as to support, in the intended manner, an outlet box to which a vertical downward force may be imparted, and a force of 200 pounds (890 N) is to be applied to the box for 5 minutes.

26.3.3 (26.3.3) A 52 ± 1 inch (1320 ± 25 mm) diameter test fan, weighing or ballasted to weigh 35 ± 1 pounds (15.8 ± 0.5 kg) and having four blades, is to be used for the tests. A 40-gram (1.4 ounces) imbalance is to be placed at the center of gravity of one blade, as measured without the bracket. The fan is to be provided with a downrod of rigid metal pipe of a length to position the lower edge of the fan blades 12 ± 1 inches (305 ± 25 mm) below the surface of the ceiling after mounting. The downrod is to be welded at the upper end to a 5/16 inch (7.9 mm) thick fan mounting bracket. The fan mounting bracket is to be secured to the outlet box in accordance with the outlet box installation instructions. No. 8-32 screws or nuts are to be tightened to 20 pound-inches (2.26 N·m), and No. 10-32 screws or nuts are to be tightened to 35 pound-inches (3.96 N·m). A universal type joint mounting construction is not to be used for the test. The fan motor is to be such that the speed can be controlled with a variable voltage power supply, such as a dc motor.

31 (32A.2) Scrub-Water-Tightness Test

31.1 (32A.2.1) A floor box shall be subjected to the test described in 31.2 and 31.3. There shall be no entrance of the water-soap solution into the box.

31.2 (32A.2.2) A floor box is to be installed in a section of material representing a floor in accordance with the manufacturer's instructions.

31.3 (32A.2.3) A water-soap solution is to be prepared by mixing approximately 3 tablespoons (44 mL) of soap powder with 1 gallon (3.79 L) of water. A sufficient amount of the solution is to be poured over the cover plate of the floor box so that it will collect to a depth of 1/8 inch (3.2 mm) above any joint in 10 seconds or less. The solution is to remain over the floor box for 1 minute. The water is then to be removed and the floor box is to be examined for any leakage.

33.16 (33.16) An outlet box intended to support a ceiling-suspended fan shall be marked "Acceptable for Fan Support." See also 18.1.